TVA/PBO/R&D-90/3

Final

Environmental Information Volume

10-MW Demonstration of Gas Suspension Absorption

AirPol, Inc.
Tennessee Valley Authority

Clean Coal Technology III Program

project location:
10-MW Scrubber Test Facility
Shawnee Steam Plant
Paducah, Kentucky

prepared for:
AirPol, Inc.

prepared by:
Tennessee Valley Authority

November 1990

Legal Notice

This report was prepared by the Tennessee Valley Authority (TVA) in carrying out its statutory responsibilities. Neither TVA, the United States, nor any of their agents or employees: (1) make any warranty or representation, express or implied, as to the accuracy, completeness, usefulness, or reliability of any information, apparatus, product, method, or process discussed in this report; (2) assume any liability or responsibility for the use of, or for damages resulting from the use of, any information, apparatus, product, method, or process discussed in this report; or (3) represent that the use of any information, apparatus, product, method, or process discussed in this report would not infringe privately owned rights.

Reference herein to any specific commercial product, process, method, or service by trade name, trademark, manufacturer, or otherwise does not constitute or imply an endorsement or recommendation by TVA, the United States, or any of their agents or employees. The views and opinions of the author expressed herein do not necessarily state or reflect those of TVA.

TABLE OF CONTENTS

Section Page

LIST OF TABLES

LIST OF FIGURES

Section 1.0

INTRODUCTION

ENVIRONMENTAL INFORMATION VOLUME
10-MW DEMONSTRATION OF
GAS SUSPENSION ABSORPTION
AIRPOL, INC./TENNESSEE VALLEY AUTHORITY
CLEAN COAL TECHNOLOGY III PROGRAM
PROJECT AT
10-MW SCRUBBER TEST FACILITY
WEST PADUCAH, KY 42001

1.0 INTRODUCTION

1.1 Background

The purpose of this document is to present a site-specific environmental information volume (EIV) on a new flue gas desulfurization concept -- Gas Suspension Absorber (GSA) -- developed by F.L. Smidth miljo (FLS miljo) in response to the U.S. Department of Energy's Program Opportunity Notice DE-PSO1-89FE61825 for Clean Coal Technology III Demonstration Projects. AirPol, Inc., acting as a general contractor, is proposing to construct and operate a 10-MW GSA demonstration system at the Tennessee Valley Authority's (TVA's) Shawnee Fossil Plant in Paducah, Kentucky. Plans call for the construction of the GSA to begin in April 1991 and to be in operation by October 1991. The new GSA unit will be installed beside and cross-connected to TVA's existing 10-MW Spray Dryer/Electrostatic Precipitator (SD/ESP) demonstration unit. This will allow TVA to evaluate the GSA unit performance under the same operating conditions as the SD/ESP. TVA will run tests on the unit for approximately one year; afterwards the GSA unit will be disconnected. The main differences between the GSA system and the SD/ESP are the method in which the reagent is introduced to the flue gas and the chamber used for SO_2 absorption.

1.2 Summary of Impacts

Due to the cross-connection of the two flue gas desulfurization units, the GSA system will be able to take advantage of the existing environmental control technologies and solid waste disposal methods that are currently in effect for TVA's SD/ESP unit. By design, only one unit will be in operation at any given time.

The types, amounts, and locations of air emissions discharged by the GSA are expected to be similar to those currently produced by the SD/ESP.

Because the materials used for both processes are identical, the complexion of the solid waste stream is not expected to change. However, due to the GSA's ability to recycle 99% of the solids in the system versus the SD/ESP's 75%, less fresh lime may be consumed and lower quantities of solid wastes may be produced during flue gas scrubbing at the site.

Only favorable environmental impacts are expected to occur at the demonstration site as a result of the installation and operation of the GSA system.

Section 2.0

THE PROPOSED ACTION AND ITS ALTERNATIVES

2.0 THE PROPOSED ACTION AND ITS ALTERNATIVES

2.1 The Proposed Action

This section describes (1) the existing site and operations of TVA's Shawnee Steam Plant; (2) the SD/ESP process at the Scrubber Test Facility (STF); and (3) AirPol's proposed GSA demonstration project.

2.1.1 Site Location

The Shawnee Steam Plant Reservation is located on the Kentucky bank of the Ohio River at river mile 945, which is approximately 10 miles northwest of Paducah, Kentucky, and approximately 3 miles west of Metropolis, Illinois (see Figure 2-1). The plant site consists of several hundred acres of river floodplain and a low upland terrace developed in thick deposits of unconsolidated clays, silts, and gravel. The active plant area is situated on this terrace, which lies above the 500-yr. floodplain.

2.1.2 Existing Plant Operation

The Shawnee Steam Plant consists of 10 units. Units 1-9 are identical front-fired Babcock & Wilcox boilers (see Figure 2-2). Each unit burns pulverized coal and produces 1 million lb/h of steam at 1,800 psi and 1,000^{o}F. With the exception of unit 10, each unit is rated at 175 MW at full load. However, in 1989 the average load was substantially less than full load (109 MW per unit). Units 1-8 are fired with low-sulfur coal; units 9 & 10 are able to utilize a medium-to-high and high sulfur coal. Unit 9 supplies 10% of its total flue gas production to the scrubber test facility (STF) for desulfurization testing and conditioning. Unit 10 is a 160-MW AFBC add-on boiler which consumes coal at the rate of 68 t/h and limestone at 19 t/h. The design of the 160-MW AFBC unit allows it to accept ahigher sulfur content in its fuel than does a conventional PC boiler.*

*Note: Unit 9, a conventional PC boiler, has been granted an air quality variance by the State of Kentucky for the purposes of conducting experimental scrubber testing. See Sections 2.1.2.3.2, "Environmental Residuals", and 5.1, " Regulations and Permit Requirements".

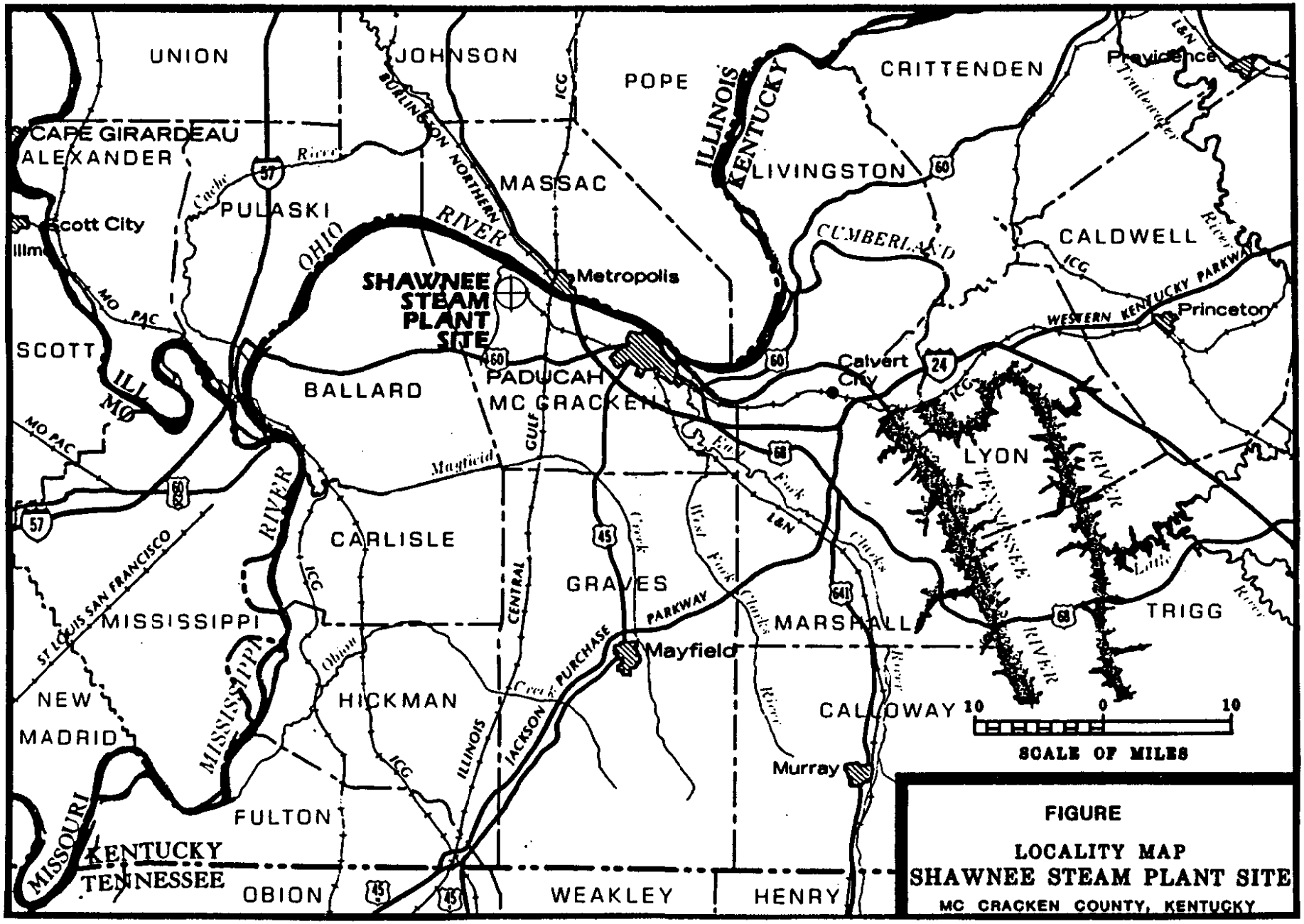
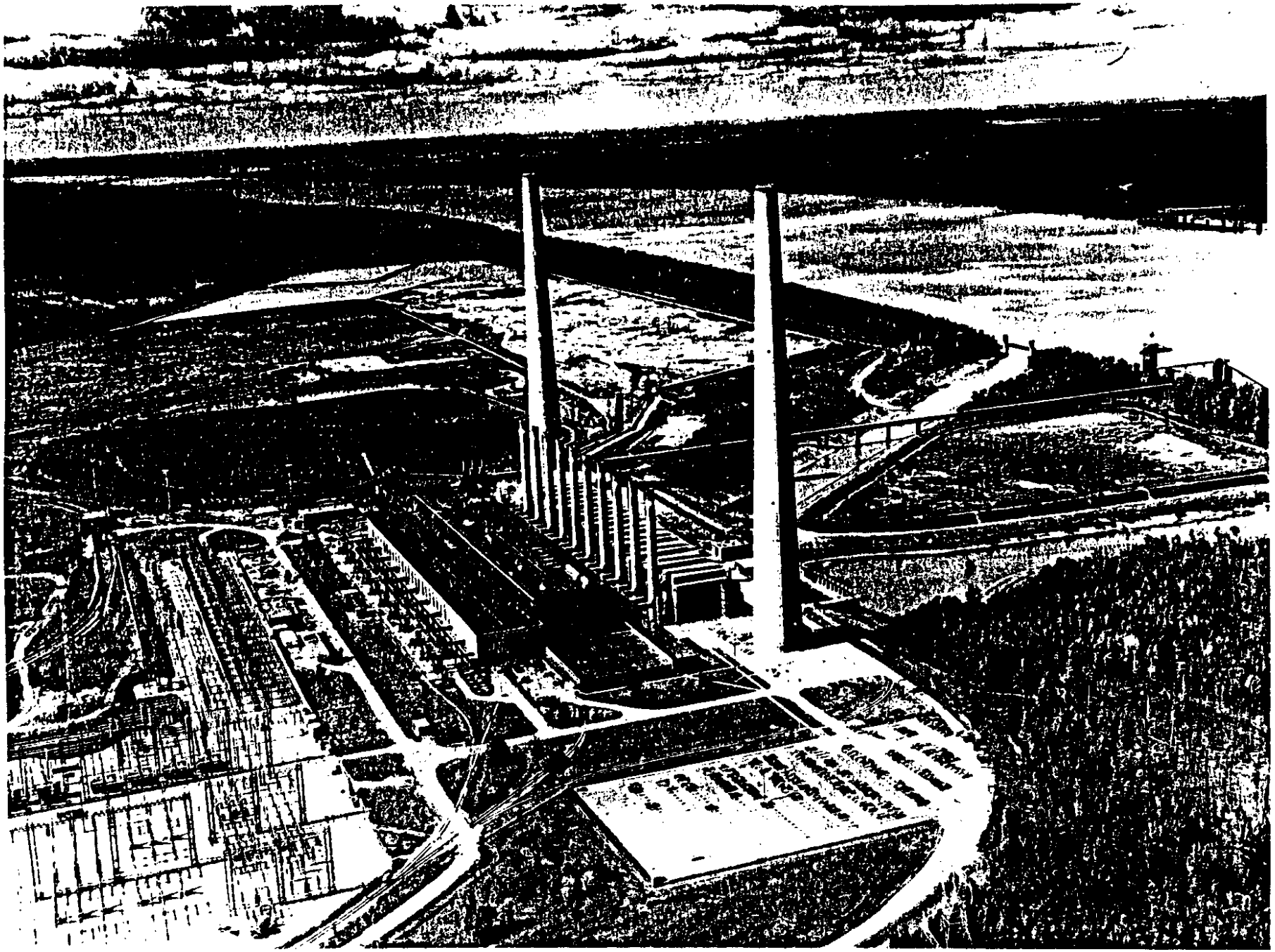

UNION
JOHNSON
POPE
CRITTENDEN
Providence
CAPE GIRARDEAU
ALEXANDER
PULASKI
MASSAC
LIVINGSTON
CALDWELL
Scott City
SHAWNEE STEAM PLANT SITE
Metropolis
OHIO RIVER
CUMBERLAND
Princeton
SCOTT
BALLARD
PADUCAH
MC CRACKEN
Calvert City
LYON
CARLISLE
GRAVES
MARSHALL
TRIGG
MISSISSIPPI
Mayfield
NEW MADRID
HICKMAN
CALLOWAY
Murray
FULTON
KENTUCKY
TENNESSEE
OBION
WEAKLEY
HENRY
10 0 10
SCALE OF MILES
FIGURE
LOCALITY MAP
SHAWNEE STEAM PLANT SITE
MC CRACKEN COUNTY, KENTUCKY

Figure 2-1



AERIAL VIEW OF THE SHAWNEE STEAM PLANT

Figure 2-2

Additionally, there is an off-line 20-MW AFBC Pilot Plant located at the site. Figure 2-3 is a plot plan for the Shawnee Steam Plant site. The Ohio River provides the Shawnee Steam Plant with over 1,500 million gallons of water daily for its various operations. The majority of this water is employed in the cooling condensers and cooling and lubricating equipment. Figure 2-4 shows the waste water flow for the entire plant. (1)

2.1.2.1 Scrubber Test Facility

The STF is located adjacent to units 9 and 10 (about 250 ft. north of the power plant). A plan view of the test facility in relation to the power plant is shown in Figure 2-5. All electrical power for the STF is obtained from the Shawnee Steam Plant.

Approximately 67,000 gallons of water are used by the STF daily in its operations. The majority of this water is used to cool equipment (about 36,600 gpd); the remainder (30,400 gpd) is used in slaking lime, making up the recycle slurry, and sluicing non-recycled solids to an existing ash pond. The STF receives its water from a metered tap into a 36" line that supplies the Martin-Marietta Gaseous Diffusion Plant. Martin-Marietta operates the pumping station at the Shawnee intakes and draws water from the Ohio River. (2) Table 2-1 shows the waste water discharges associated with the existing SD/ESP system at the STF.

The STF presently consists of a 10-MW SD/ESP, the associated feed preparation and waste handling systems, an analytical laboratory, and various operation and support buildings. The plan and elevation drawings of the STF are shown in Figures 2-6 and 2-7, respectively.

The 10-MW SD/ESP Flue Gas Desulfurization (FGD) system is a relatively simple process with few major equipment items, most of

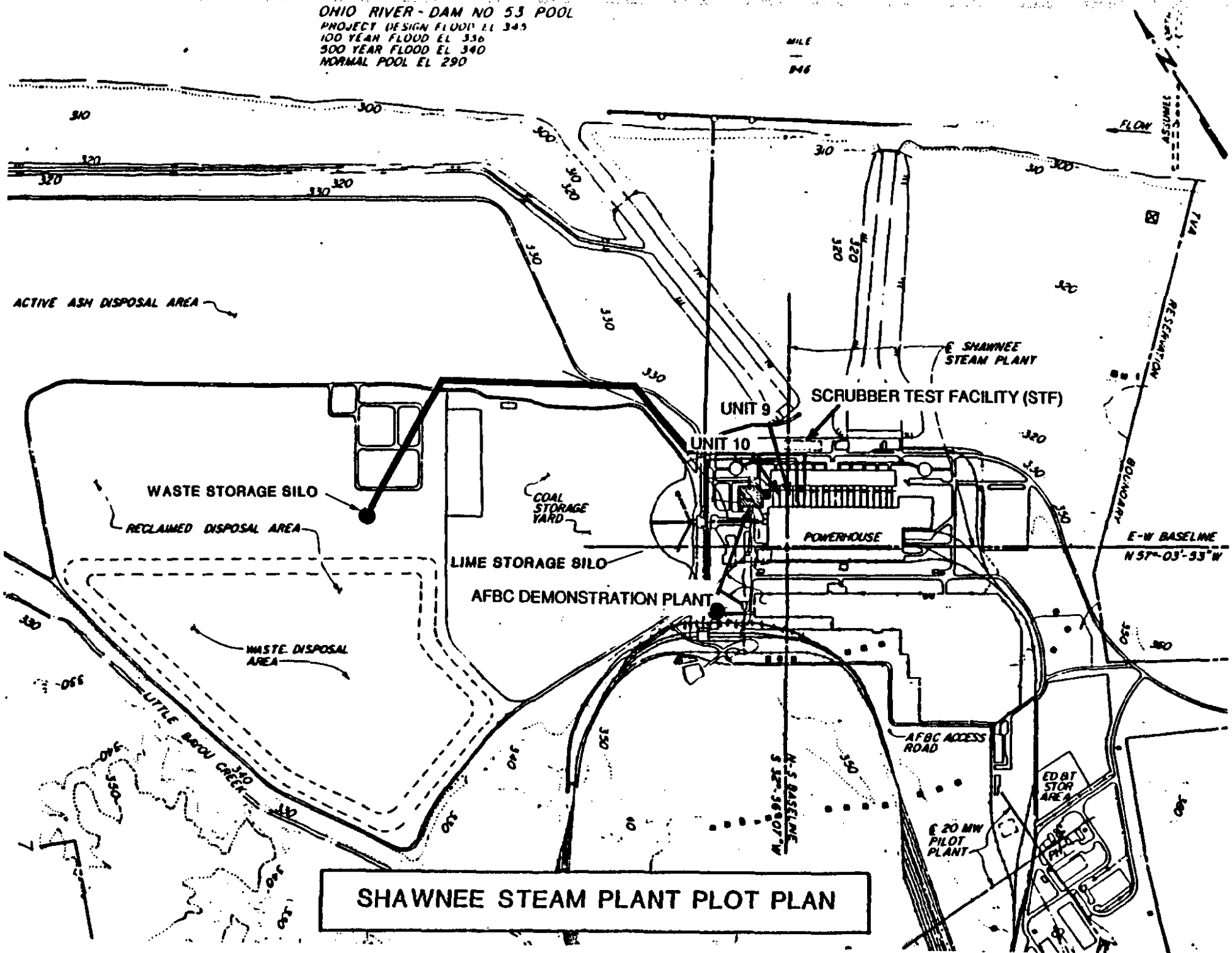
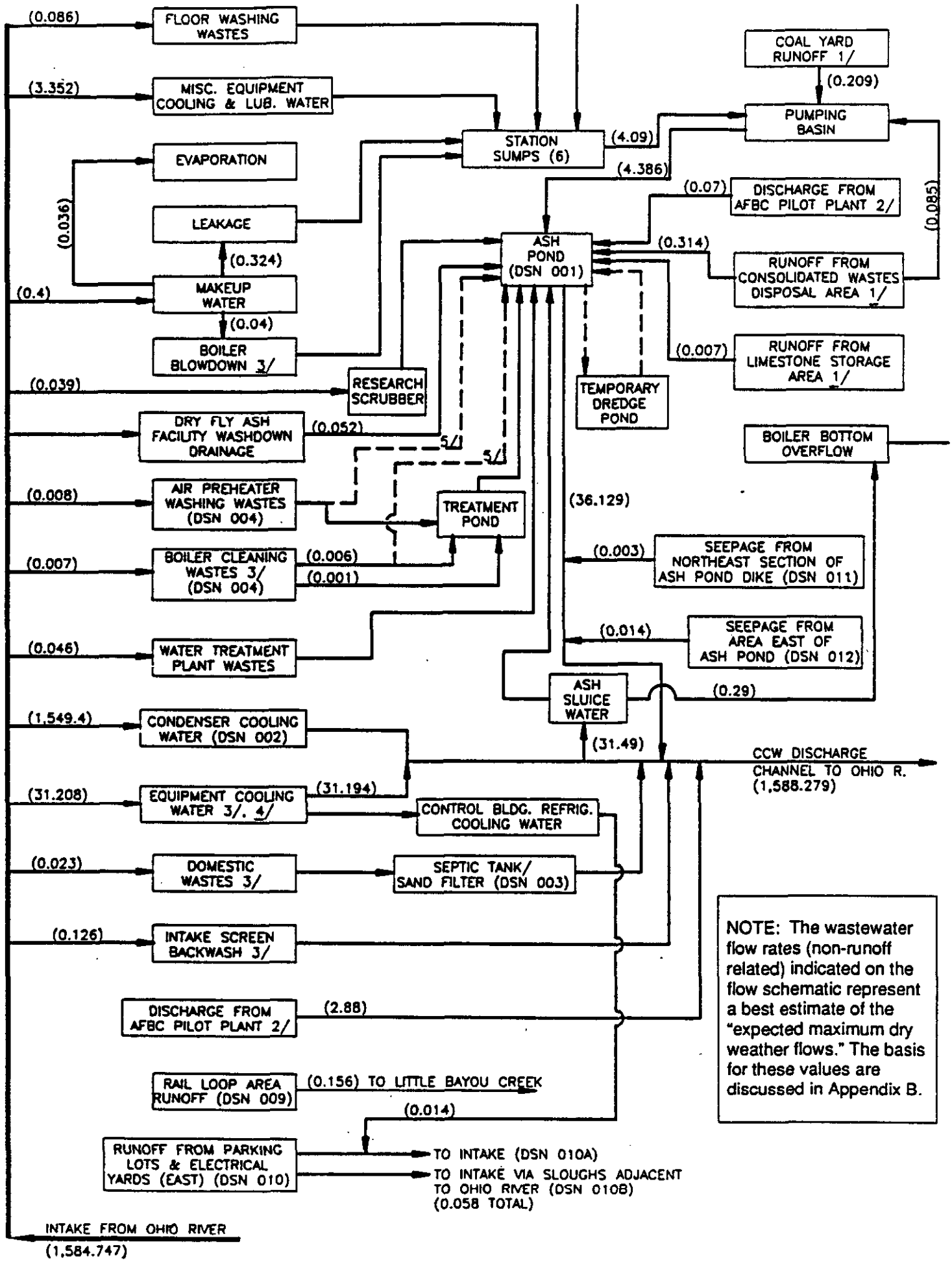
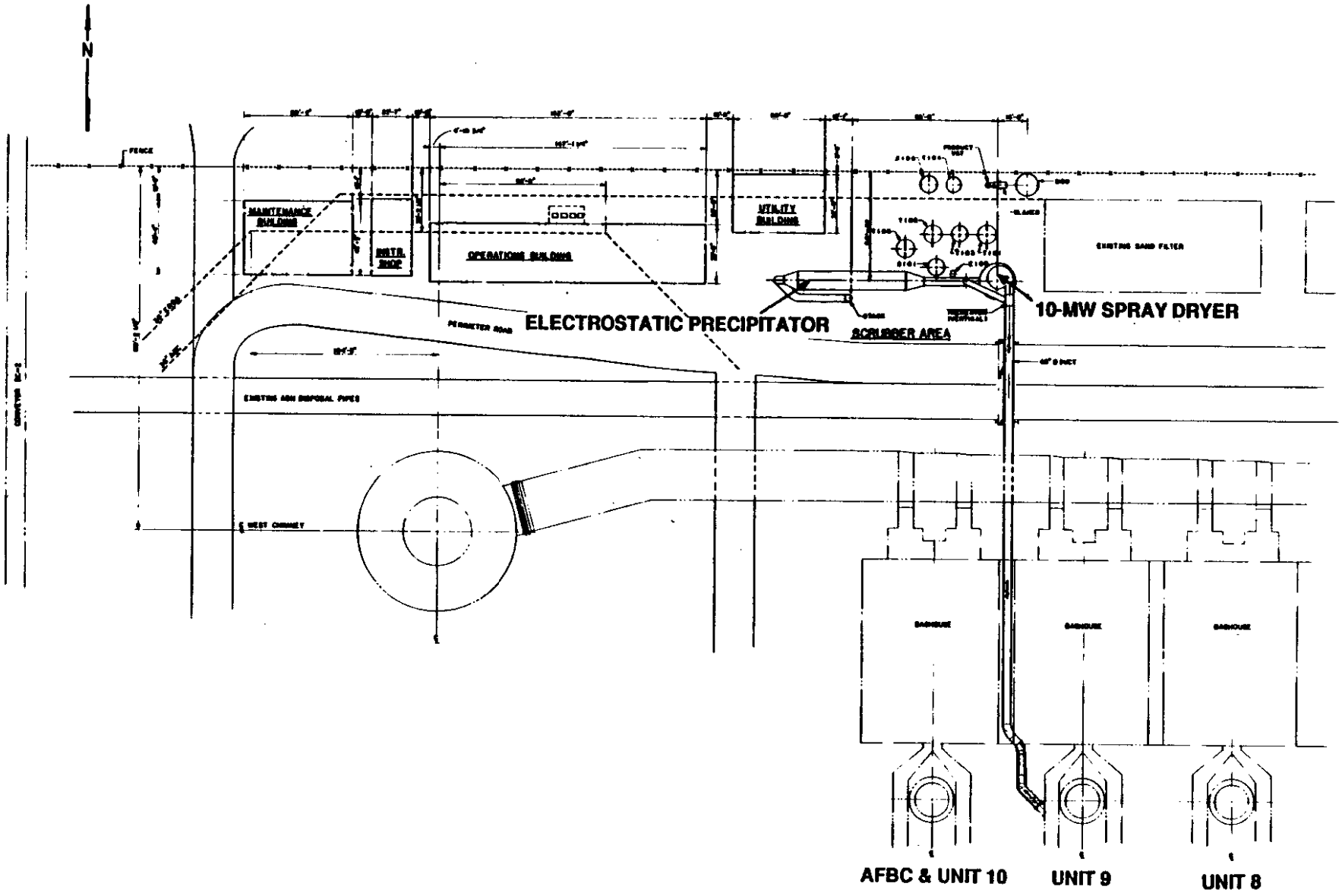

OHIO RIVER - DAM NO 53 POOL
PROJECT DESIGN FLOOD EL 345
100 YEAR FLOOD EL 336
500 YEAR FLOOD EL 340
NORMAL POOL EL 290
ACTIVE ASH DISPOSAL AREA
WASTE STORAGE SILO
RECLAIMED DISPOSAL AREA
WASTE DISPOSAL AREA
COAL STORAGE YARD
LIME STORAGE SILO
AFBC DEMONSTRATION PLANT
UNIT 9
UNIT 10
SCRUBBER TEST FACILITY (STF)
℄ SHAWNEE STEAM PLANT
POWERHOUSE
E-W BASELINE
N 51°-03'-33" W
AFBC ACCESS ROAD
ED BT STOR AREA
℄ 20 MW PILOT PLANT
LITTLE BAYOU CREEK
FLOW
TVA
SHAWNEE
BOUNDARY
SHAWNEE STEAM PLANT PLOT PLAN

Figure 2-3



SHAWNEE STEAM PLANT WASTEWATER FLOW SCHEMATIC

Figure 2-4



PLAN VIEW OF THE SCRUBBER TEST FACILITY RELATIVE TO THE POWER PLANT

Figure 2-5

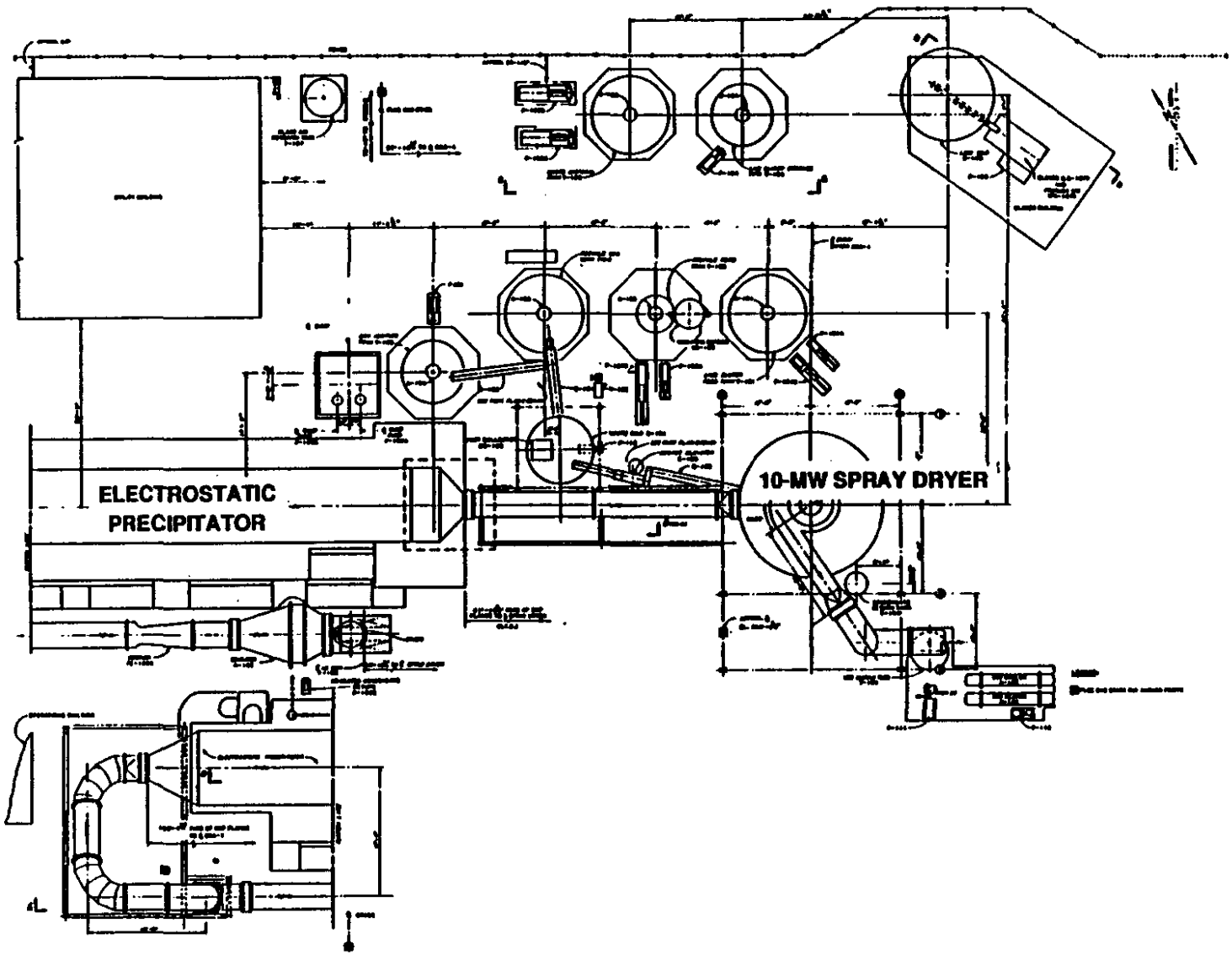
Table 2-1

WASTEWATER DISCHARGES ASSOCIATED WITH THE SPRAY DRYER/ELECTROSTATIC PRECIPITATOR (SD/ESP) DESULFURIZATION SYSTEM

	ACREAGE	AMOUNTS	DISCHARGE POINT
1. Lime Storage Area Sump	Enclosed Area	Intermittent	Coal Pile Drainage
2. Reagent/Recycle Area Sump	Enclosed Area	Intermittent	Shawnee Ash Pond via Bottom Ash Line
3. Waste Silo Area Sump	Less Than 1/4 Acre	Intermittent	Shawnee Ash Pond with Waste Disposal Runoff
4. Raw Water Supply Filter Backflushing	----	200 gpm (max.)	Shawnee CCW via Storm Drainage
5. Waste Disposal Area Runoff	TBD*	TBD*	Shawnee Ash Pond
6. Sanitary Waste (No Significant Increase)	----	----	Sanitary Waste Treatment System

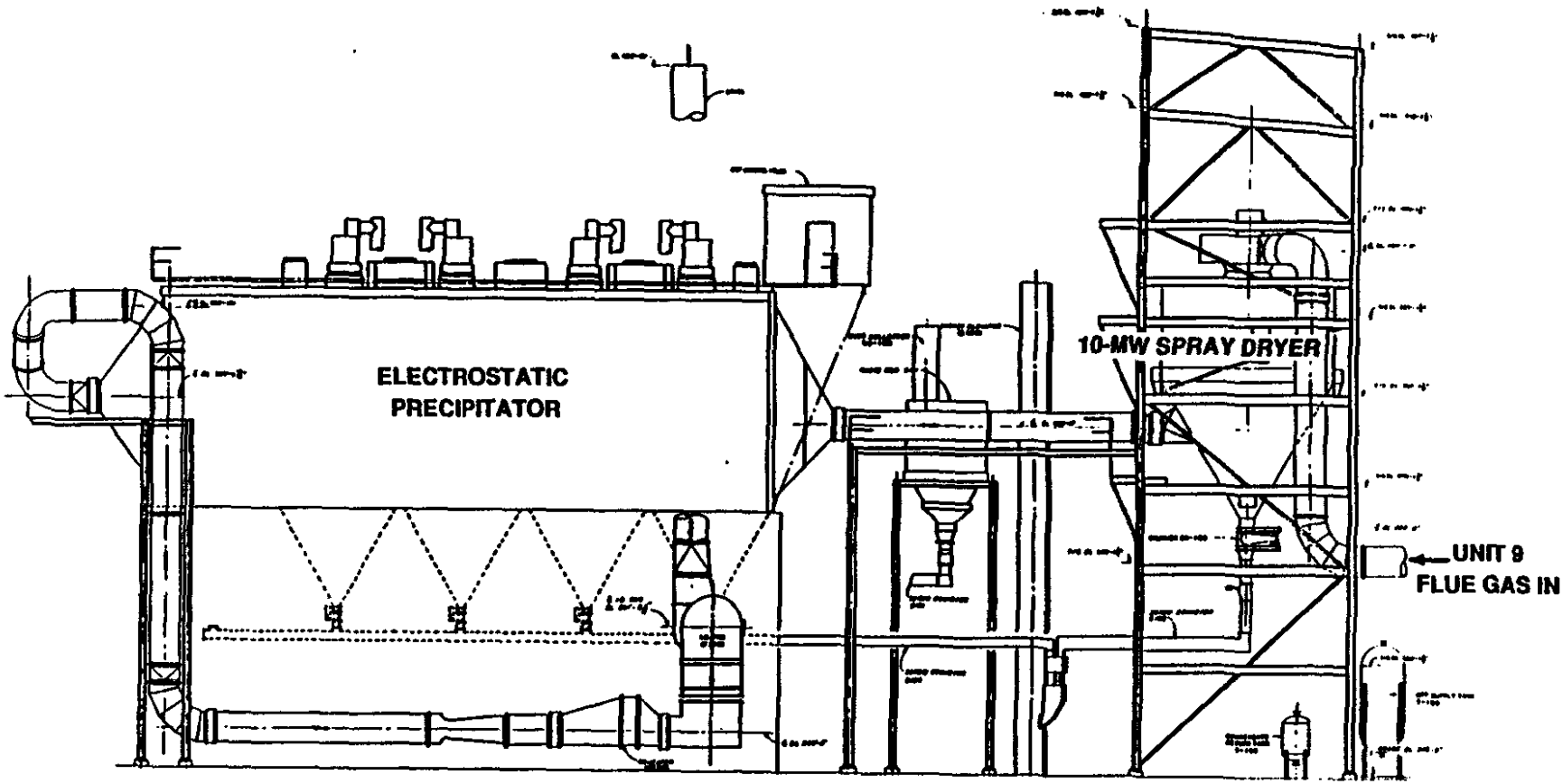
* - To Be Determined

Source:
Kentucky Department for Environmental Protection,
Division of Water, Permit Modification for National Pollutant
Discharge Elimination Permit # KY0004210,
Attachment 4.



PLAN VIEW OF THE SCRUBBER TEST FACILITY

Figure 2-6



ELEVATION VIEW OF THE SCRUBBER TEST FACILITY

Figure 2-7

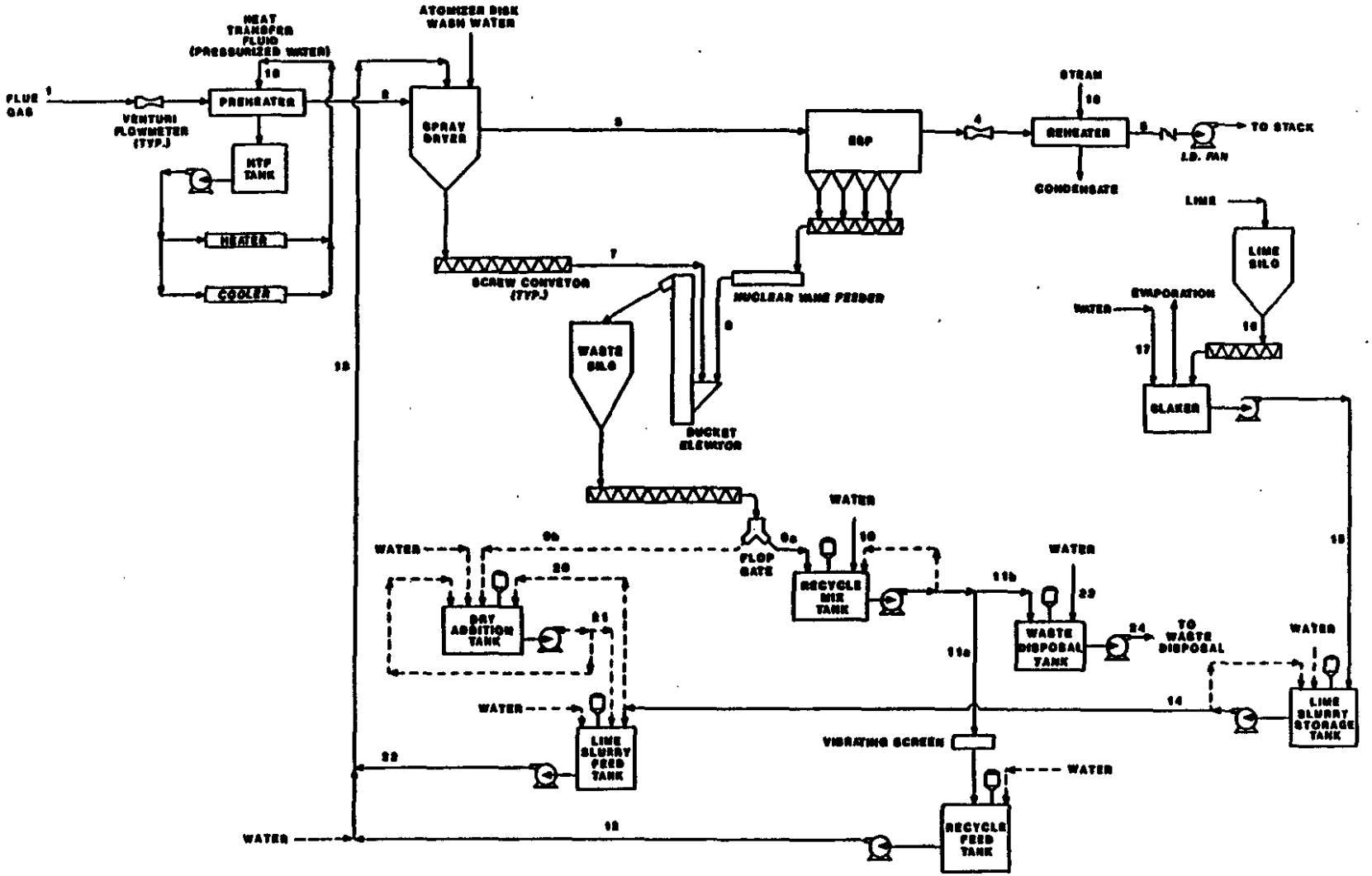
which have been commercialized in other industries and have simply been adapted to an FGD application. The major equipment items are a spray dryer, an ESP, and an induced-draft (ID) fan for handling the flue gas, and a slaker for preparing the lime feed slurry. A discussion of the SD/ESP process and a description of the STF follow.

2.1.3 SD/ESP Process Description

The process flow diagram for the SD/ESP at the STF is shown in Figure 2-8. Currently a medium-to-high sulfur Pyro coal is being burned at the STF. Prior to its use, Warrior coal was burned as a high-sulfur fuel for testing of the SD/ESP. The ultimate analyses for Warrior and Pyro coals are given in Table 2-2. Flue gas for the STF is withdrawn from the unit 9 upstream of the baghouse but downstream of the mechanical ash precollectors. The flue gas temperature and pressure from unit 9 is 270 to 310°F and approximately -15 in. of water. The flue gas flows through an insulated 40-in. diameter duct about 250 ft. to the test facility. This inlet duct passes through the Shawnee unit 9 baghouse building for part of this distance.

The inlet flue gas flow rate to the facility is measured by a venturi flow-meter; and the flue gas temperature, pressure, and SO_2 and O_2 concentrations are also determined. Upon exiting the venturi, the flue gas passes through an in-duct heat exchanger which controls the flue gas temperature within the range from 260 to 340°F. From the heat exchanger, the flue gas flows to the inlet of the spray dryer vessel where the flue gas wet- and dry-bulb temperatures, pressure, and O_2 and SO_2 concentrations are measured.

The flue gas enters the spray dryer through a scroll duct located at the top of the spray dryer. The scroll imparts a swirl to the flue gas which then enters the spray dryer vessel through a concentric ring of turning vanes surrounding the rotary atomizer. This design results in turbulent



SPRAY DRYER/ELECTROSTATIC PRECIPITATOR PROCESS FLOW DIAGRAM

Figure 2-8

Table 2-2
ULTIMATE ANALYSIS FOR WARRIOR AND PYRO COALS

	RANGE (%)	
	WARRIOR COAL [a]	PYRO COAL [a, b]
Carbon	67.0 - 69.3	73.0 - 75.3
Hydrogen	4.5 - 4.7	5.0 - 5.2
Nitrogen	1.4 - 1.5	1.5 - 1.6
Oxygen	5.0 - 8.1	6.1 - 6.9
Sulfur	3.5 - 4.5	2.47 - 2.99
Chlorine	0.02 - 0.07	0.24 - 0.34
Moisture (as received)	8 - 12	8 - 12

[a] 12,000 - 13,000 Btu/lb Dry Basis
[b] Primary Fuel

gas flow around the atomizer. The alkaline slurry containing both lime and recycle slurry is fed to a 12.6-in. diameter atomizer wheel that is rotating at 12,900 r/min. The atomizer wheel has four 8-mm diameter openings, located 90 degrees apart, around the outside edge. These openings are lined with silicon carbide inserts to resist abrasion. As the slurry passes through these openings to the outside circumference of the wheel, the slurry is sheared off into the flue gas and forms very fine droplets. The rotary atomizer is a variable speed design and is powered by a 100-hp motor. The motor gearbox and atomizer, which comprise the atomizer system, are a vertical inline design with the shafts on a common centerline. The finely atomized alkaline slurry containing both lime and recycle slurry is introduced into this turbulent flue gas to ensure rapid mixing of the two streams. This intimate mixing of the flue gas and alkaline slurry promotes the absorption of the acid gasses (SO_2, SO_3, and HCl) from the flue gas into the slurry droplets where the chemical reactions which convert the SOx in the flue gas to calcium sulfite and calcium sulfate and the HCl to calcium chloride occur. The water in the slurry droplets is simultaneously evaporated by the hot flue gas, thereby drying the reaction products and cooling and humidifying the flue gas. The spray dryer has a cylindrical upper level which is 19 ft. 6 in. in diameter and 11 ft. 9 in. high and contains a 60-degree cone bottom which is 17 ft. high. The flue gas swirls downward through this upper cylindrical portion of the spray dryer and into the cone bottom. The flue gas then reverses direction and flows upward into the bottom opening outlet duct which then makes a 90-degree turn and passes out the side of the spray dryer vessel. This design results in the spray dryer vessel acting as a low efficiency mechanical collector which removes a portion of the particulate matter entrained in the fluegas as it exits the spray dryer. The spray dryer is designed for a flue gas residence time of 10 seconds, based on the outlet flue gas conditions. The design inlet flue gas flow rate is 35,000 acf/m at 320°F under normal operating conditions.The flue gas from the spray dryer passes through a horizontal duct to the ESP where

most of the entrained particulate matter is removed. The flue gas temperature and pressure are measured at both the exit of the spray dryer and the inlet of the ESP. The O_2 concentration is measured at the spray dryer exit. The SO_2 concentration is measured only at the ESP inlet, but the readings are checked with a redundant SO_2 monitor at the same location.

The ESP is a 4-field unit typical of existing ESPs in the utility industry in general and within TVA in particular. The housing contains room for five fields; however, the fifth field is vacant. The ESP has 13,528 ft^2 of collecting plate area arranged such that the ESP has eight parallel gas passages. At the design ESP inlet flue gas rate of 30,300 acf/m, this corresponds to an SCA of 446 ft^2/kacf/m and a face velocity of 3.3 ft/s. The aspect ratio is 1.60. Each field has a separate hopper and double-flap discharge valve for solids storage and removal. The charging electrodes are Flakt-spiral stainless steel wires mounted in a rigid frame. The collector plates are spaced 10 in. apart. Both discharge and collector electrodes are rapped by tumbling hammers on a rotating shaft. A microprocessor-based system controls the voltage to the transformer-rectifier (T/R) and sets the required rapping sequence.

The flue gas temperature, pressure, and SO_2 and O_2 concentrations are measured again at the ESP outlet. Downstream of the ESP, the flue gas passes through the outlet venturi where the flue gas flow rate is measured again.

The flue gas then enters an in-duct, indirect steam heat exchanger to reheat the flue gas to 200°F to protect the ID fan, exhaust ductwork, and stack from corrosion. This was done to protect the pilot-plant equipment during the numerous startups and shutdowns. Reheating

may not be necessary for a full-scale SD/ESP. After reheating, the flue gas passes through the ID fan and exits the pilot plant through a 150-ft. stack.

The particulate matter which drops out of the flue gas in the spray dryer falls to the bottom of the cone and passes through a delumper and then a double-flap valve to a screw conveyor which feeds the solids to a bucket elevator. The particulate matter collected in the ESP hopper is also transported to the same bucket elevator by a screw conveyor. The elevator moves the solids to a waste silo for in-process storage. The solids in the waste silo are fed to the recycle mix tank where the solids are mixed with water to form recycle slurry typically containing 35-percent solids by weight, but up to 45-percent solids slurry can be prepared. The recycle mix tank has a storage capacity of 5,200 gal. When recycle slurry is required in the process, the recycle slurry is pumped to a 10-mesh vibrating screen where oversize particles are removed. The resulting recycle slurry underflow falls by gravity to the 3,200-gal. recycle slurry feed tank. From the feed tank, the recycle slurry is pumped to a tee in the feed line where the recycle slurry mixes with the fresh lime slurry and flows to the atomizer through a common feed line. Recycle slurry not required in the process is transferred to the 5300-gal. waste disposal tank and diluted with water to generate a slurry containing approximately 10-percent solids. The resulting diluted slurry is pumped to the ash pond for ultimate disposal with the fly ash and bottom ash from the boilers.

The high-calcium pebble lime used at the STF is purchased from the Mississippi Lime Company of St. Genevieve, Missouri. The specifications for this lime are shown in Table 2-3. The lime is delivered by truck and pneumatically conveyed to the lime storage silo. The lime storage silo has a capacity of 107 tons of pebble lime. The pebble lime falls by gravity from the storage silo into a screw conveyor which feeds the detention-type slaker. The lime slurry from the slaker

Table 2-3
LIME SPECIFICATIONS

CHARACTERISTICS	SPECIFICATION
Composition	
Available CaO	93% Minimum
Total CaO	95% Minimum
MgO	2% Maximum
SiO_2	1% Maximum
Size	1/2 in. Nominal (5/8 in. plus 1/4 in.)
Reactivity	As Per ASTM C110.2.2 Slaking Rate Test Must Achieve 40°C Temperature Rise in 3 Minutes or Less.

is pumped to a storage tank. As needed in the process, the lime slurry is pumped to the lime slurry feed tank. The water/lime ratio is used to control the slaker, which is capable of producing 10 to 15 gal./min. of 25-percent solids slurry. The lime slurry storage tank and the lime slurry feed tank have capacities of 7,500 gal. and 5,200 gal., respectively. (3)

2.1.4 Description of AirPol's Gas Suspension Absorber Project

AirPol's objective is to install and test it's 10-MW gas suspension absorber (GSA) in lieu of the TVA's existing 10-MW SD/ESP currently in operation at TVA's STF.

This project will be the first North American demonstration of the GSA system in its application for flue gas desulfurization. The purpose of this project is to demonstrate the high sulfur dioxide (SO_2) removal efficiency as well as the cost effectiveness of the GSA system.The GSA equipment developed through executing this project will be used for future commercialization of the GSA system. Results of the operation and experimental testing will be used to further improve the GSA design and operation.

The specific technical objectives of the GSA demonstration project are to:

- Effectively demonstrate SO_2 removal in excess of 90% using high sulfur U.S. coal.
- Optimize recycle and design parameters to increase efficiencies of lime reagent utilization and SO_2 removal.
- Compare removal efficiency and cost with existing Spray Dryer/Electrostratic Precipitator technology.

2.1.4.1 Description of Project Phases

In order to accomplish these objectives, the demonstration project is divided into 3 phases. The phases, along with the scheduled beginning and completed dates, and tasks are shown below:

Phase I - Engineering and Design (08/01/90 - 01/31/91)
- Task I - Project and Contract Management
- Task II - Process and Technology Design
- Task III - Environmental Analysis
- Task IV - Engineering Design

Phase II - Procurement and Construction (02/01/91 - 09/30/91)
- Task I - Project and Contract Management
- Task II - Procurement and Furnish Material
- Task III - Construction and Commissioning

Phase III - Operation and Testing (10/01/91 - 09/30/92)
- Task I - Project Management
- Task II - Start-up and Training
- Task III - Experimental Testing and Reporting

AirPol, acting as the general contractor, will take the lead in all efforts required for the execution of the demonstration project. AirPol will be performing all the major tasks during Phase I and Phase II of the project, and is to actively participate in the Phase III operation and testing activities. Phase III is scheduled to last one year. TVA, the test site host, will assist AirPol with inputs of site related information during Phase I and II, and shall perform all operating and testing tasks during the Phase III period. FLS miljo, in the capacity of technical consultant, will provide technical assistance and engineering guidance to AirPol throughout the entire period of the project. (4)

2.1.4.2 Project Configuration, Installation, Process Description and Process Chemistry

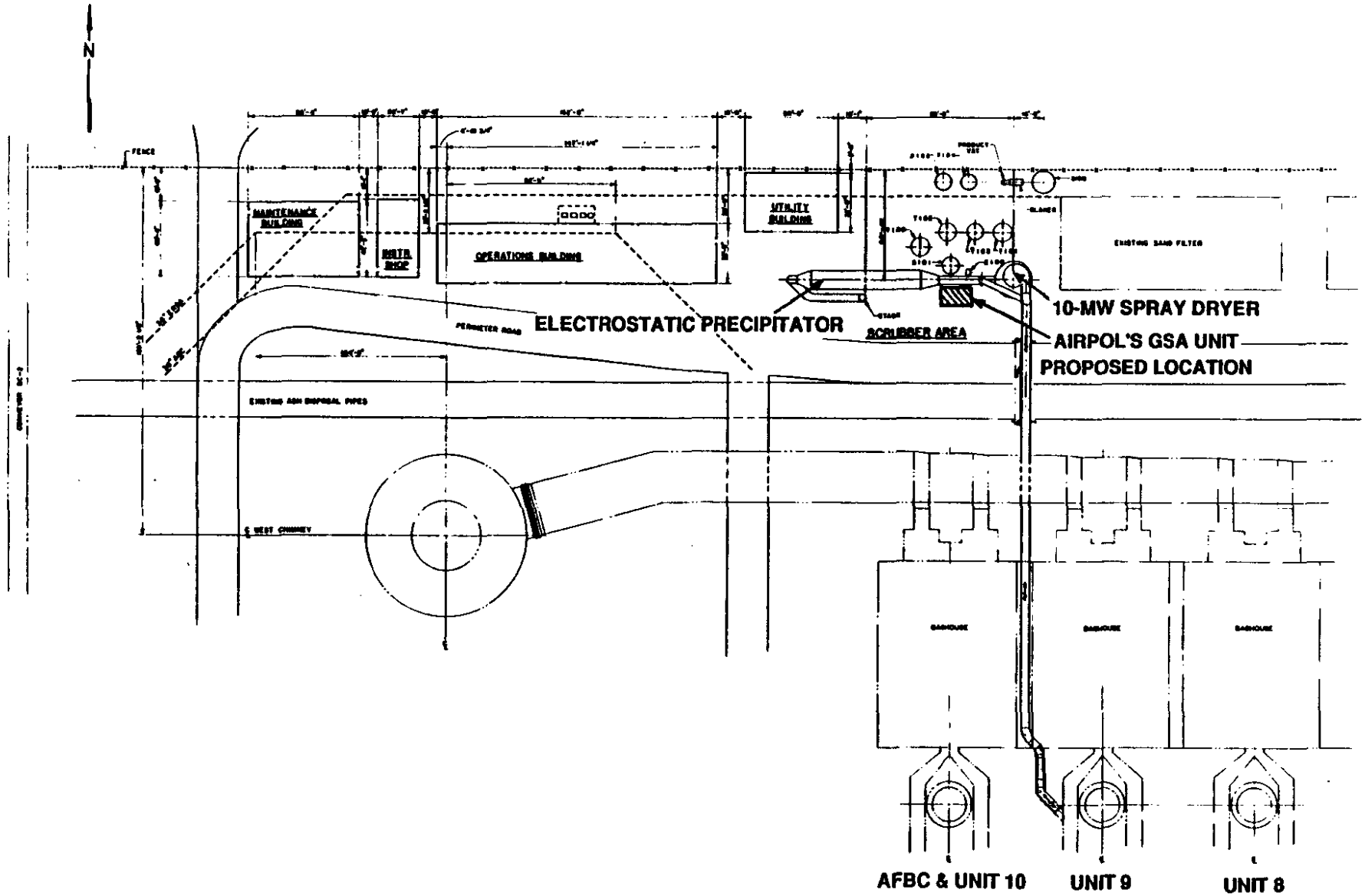
The proposed GSA system is compact. The building that will house the unit will be about 87 ft. in height and have a footprint that is approximately 30ft.x40ft. The compact modular nature of the GSA will allow it to be easily placed between and cross-connected to

TVA's existing spray dryer building and its associated ESP. Figures 2-9 and 2-10 indicate the proposed location of the unit. Figure 2-11 gives a general arrangement plan view of the GSA unit relative to the existing spray dryer, and Figure 2-12 shows the GSA reactor and cyclone general arrangement.

2.1.4.2.1 GSA Process Description

Acid flue gas will be fed through the GSA from TVA's unit 9 boiler (10% total flue gas output) and will be conveyed to the bottom of the GSA reactor and mixed with suspended solids and lime slurry. The slurry will be suspended in the reactor by the gas stream, during which the slurry will be dried and SO_2 will be absorbed and neutralized by the reaction with lime. The major product to be discharged will be calcium sulfite and sulfate. An artist's conceptual drawing of a full-scale GSA unit is shown in Figure 2-13. Figure 2-14 is a simplified process flow diagram.The partially cleaned flue gases are passed on via the separating cyclone to an existing electrostatic precipitator for particulate collection. The flue gases which have now been cleaned are now ready to be released via an existing stack. The solids containing the calcium salts, ash, and unreacted lime are separated in the cyclone. About 99% of the solids will be fed back to the reactor via a screw conveyor, while only about 1% will leave the system in the form of by-product. The solids will be returned to the inlet of the reactor, thereby maintaining a high concentration of solids in the reactor. This ensures an effective absorption of gases and a continuous cleaning of the inner surface of the reactor.

Unused lime in the ash will get another chance to react with the acids thereby lowering the overall consumption of lime. The recirculation may, therefore, result in lower operating costs than experienced with conventional semi-dry scrubbers.



PLAN VIEW OF THE SCRUBBER TEST FACILITY SHOWING THE PROPOSED LOCATION OF AIRPOL'S GSA UNIT

Figure 2-9

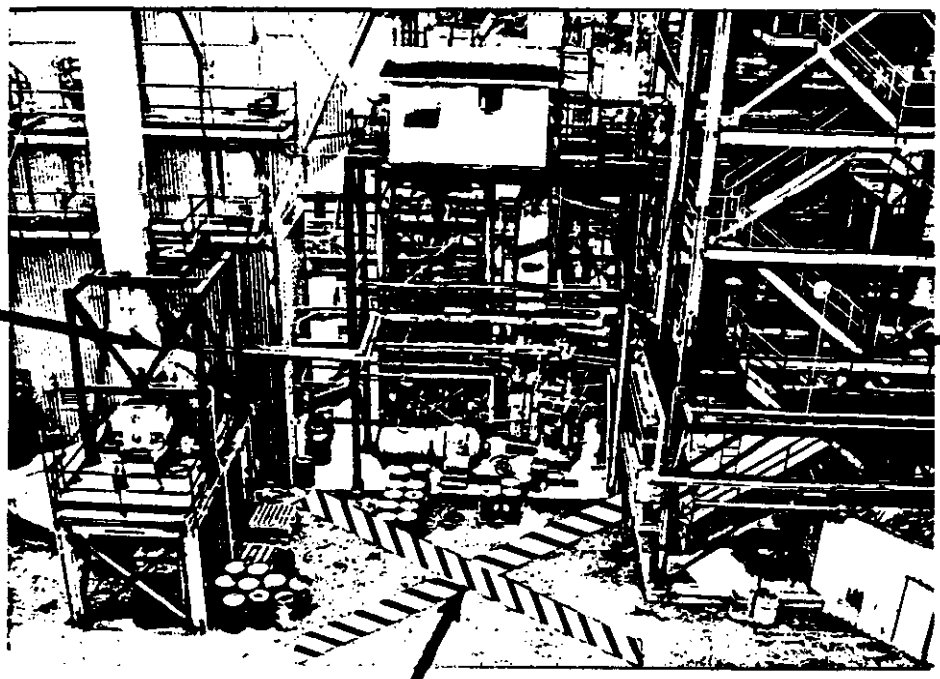


Figure 2-10
PROPOSED LOCATION FOR THE INSTALLATION OF AIRPOL'S GSA UNIT IN RELATION TO EXISTING EQUIPMENT

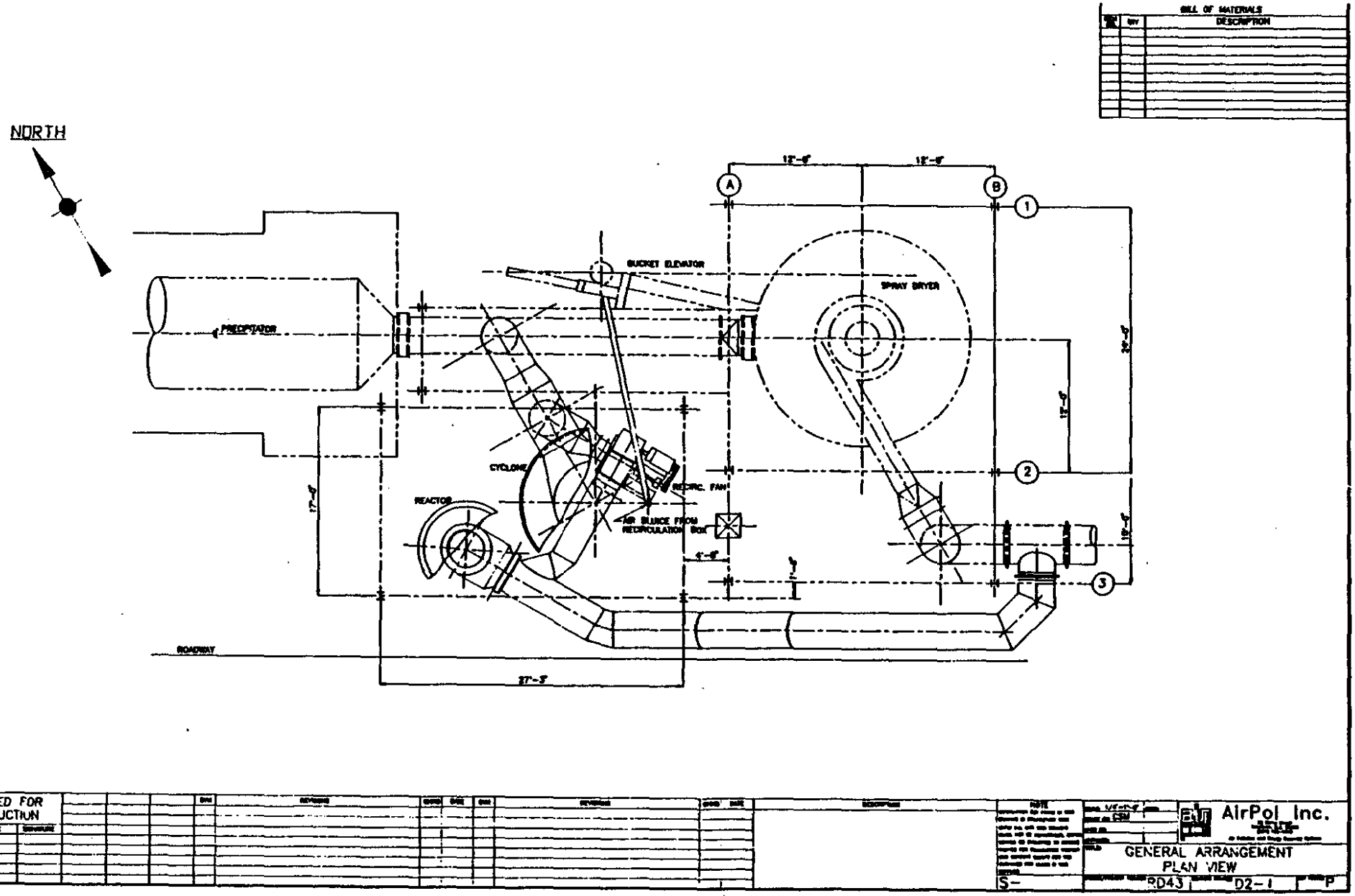

NORTH
BILL OF MATERIALS
DESCRIPTION
PRECIPITATOR
BUCKET ELEVATOR
SPRAY DRYER
CYCLONE
REACTOR
RECIRC. FAN
AIR SLUICE FROM RECIRCULATION BOX
ROADWAY
A
B
1
2
3
APPROVED FOR CONSTRUCTION
AirPol Inc.
GENERAL ARRANGEMENT
PLAN VIEW
RD43
D2-1

Figure 2-11

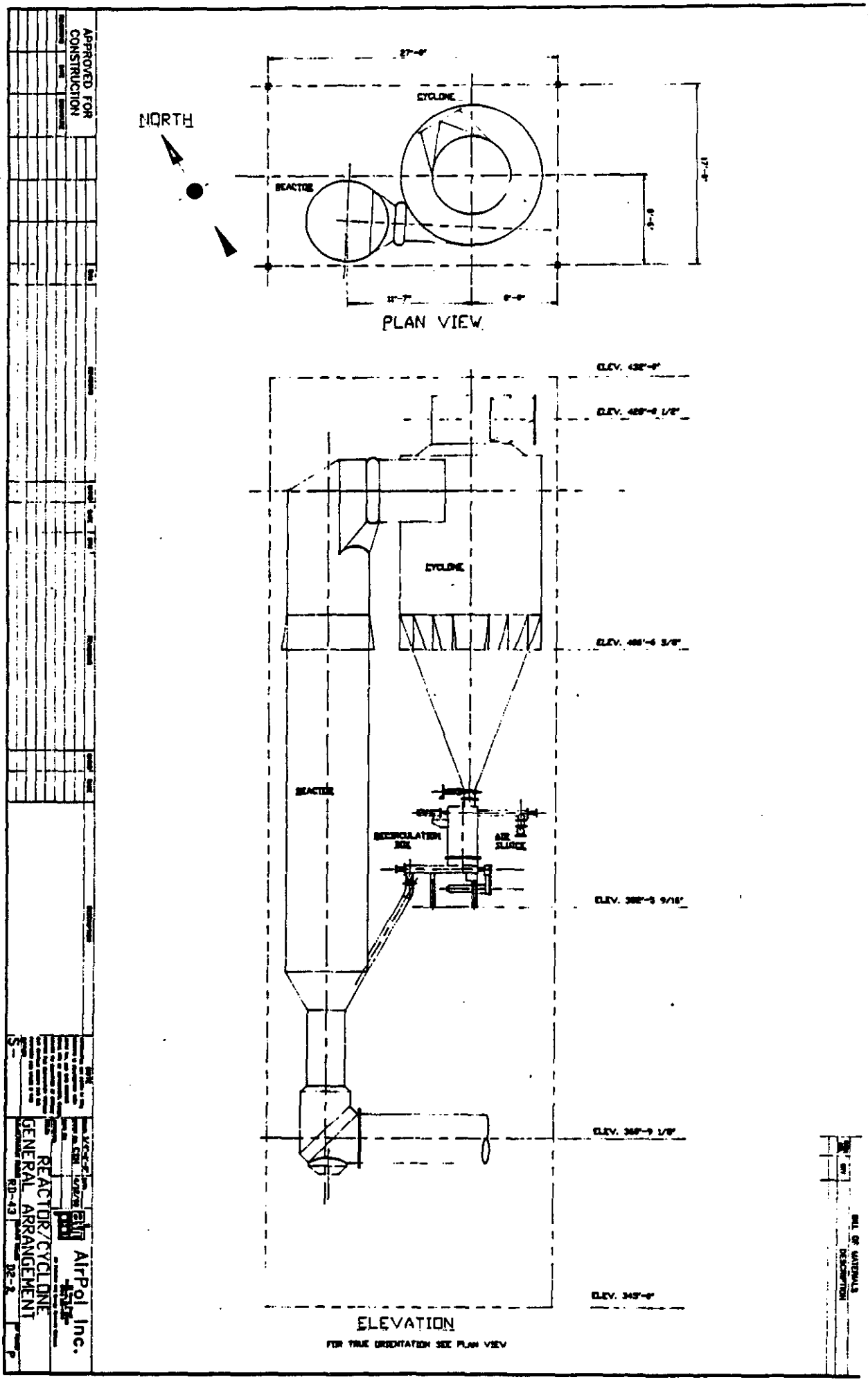
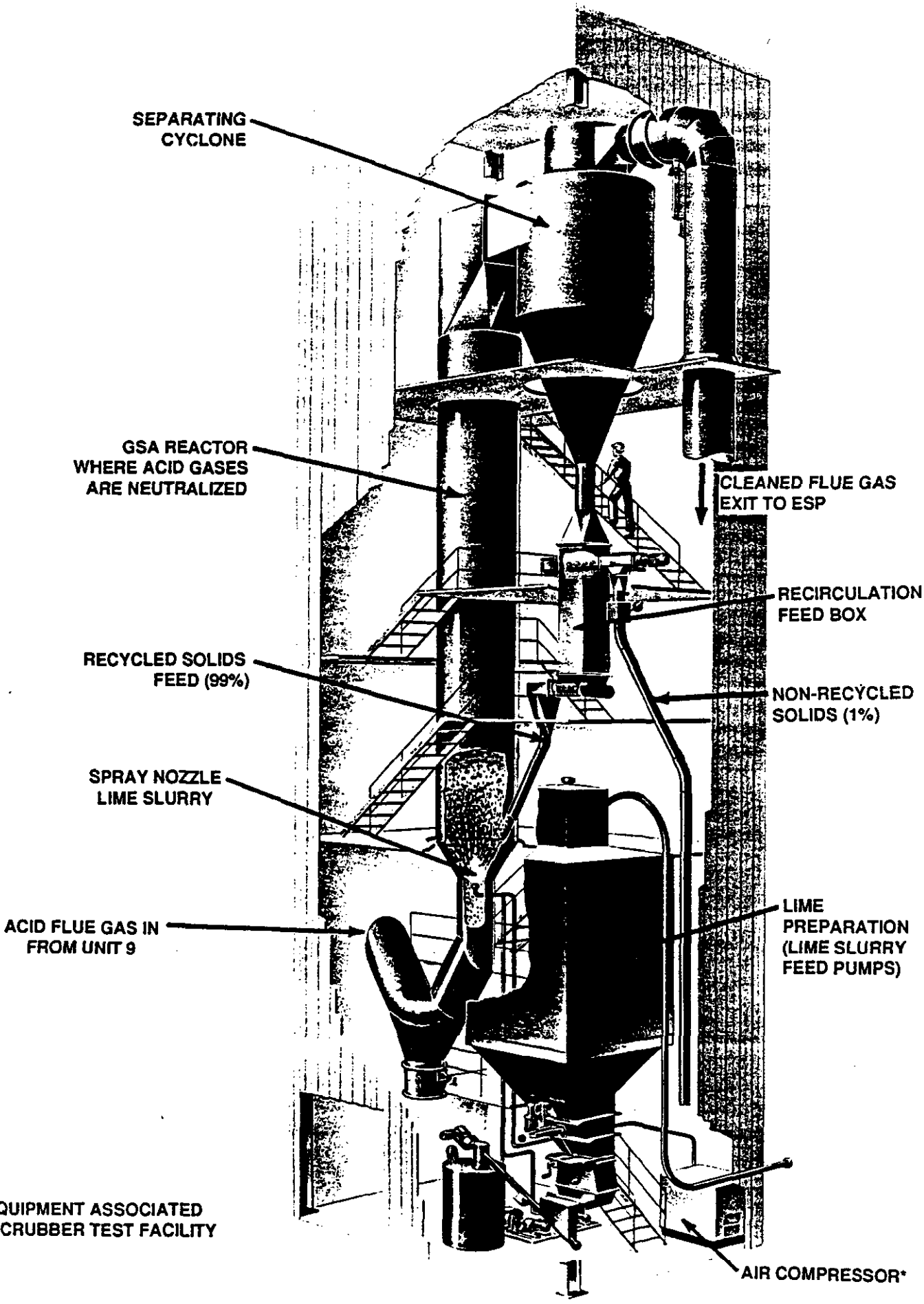

APPROVED FOR CONSTRUCTION
NORTH
CYCLONE
REACTOR
PLAN VIEW
CYCLONE
REACTOR
RECIRCULATION
AIR SLUICE
ELEVATION
FOR TRUE ORIENTATION SEE PLAN VIEW
AirPol Inc.
REACTOR/CYCLONE
GENERAL ARRANGEMENT
RD-43
BILL OF MATERIALS

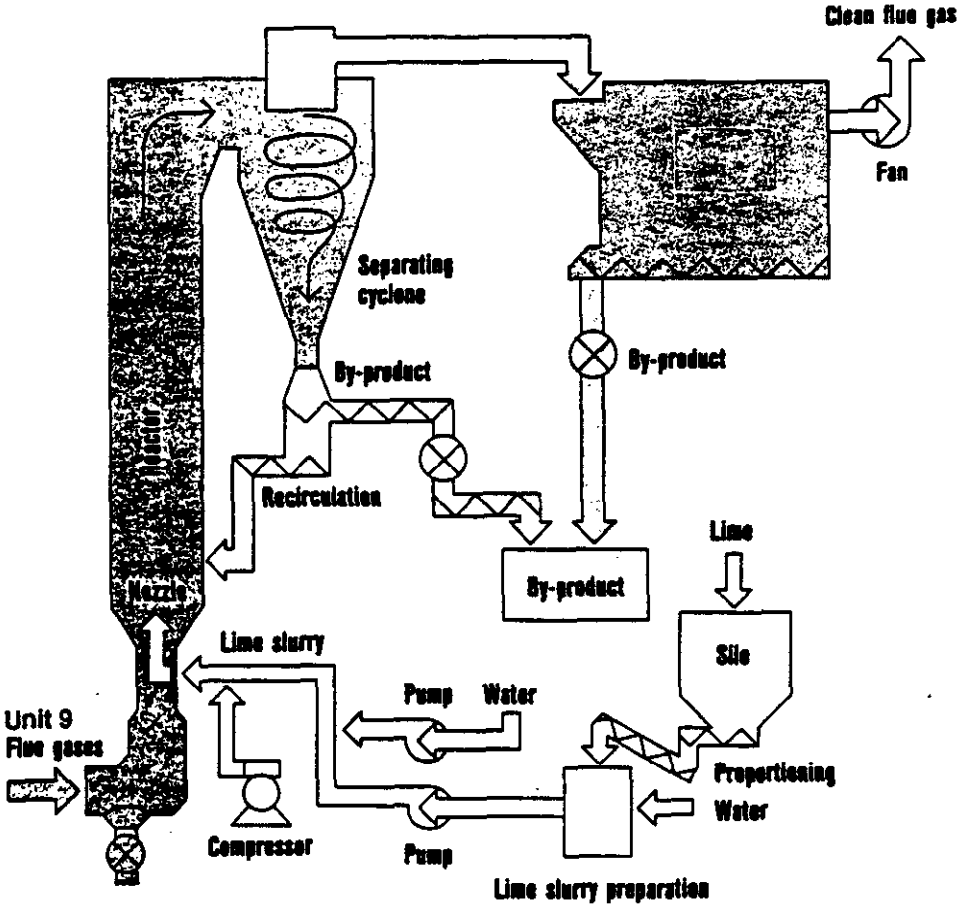
Figure 2-12



* EXISTING EQUIPMENT ASSOCIATED WITH THE SCRUBBER TEST FACILITY

ARTIST'S CONCEPT OF A FULL-SCALE GSA

Figure 2-13



Process Flow Diagram

SIMPLIFIED GSA PROCESS FLOW DIAGRAM
Figure 2-14

The solids concentration in the reactor will gradually stabilize and the surplus will continuously be discharged from the separating cyclone. This will maintain a constant concentration of solids in the reactor and ensure a stable operation of the system.

The lime slurry is prepared from hydrated lime in a separate unit and is pumped to the nozzle in the bottom of the reactor. The flow of the lime slurry is controlled by continuous measurement of the acid content downstream of the precipitator which ensures that only the required amount of lime slurry is used. Also, dilution water is pumped into the nozzle to lower gas temperature to the required operating temperature of the reaction of the above 200°F. The flow of water is controlled by continuous measurement of the gas temperature downstream of the precipitator. A stand-by pump is included for safety.

The fluid injecting pumps are all equipped with variable speed motors and are designed for considerable fluctuations in flow. The system is thus very flexible with regard to adjusting to variations in the incoming flue gas.

The atomizing nozzle in the bottom of the reactor is of heavy duty construction which resists plugging.

If the velocity of the incoming gas to the reactor (measured by a venturi gas meter) decreases to below 60% of the nominal value, the injection of lime slurry and water is stopped in order to prevent clumping in the bottom of the reactor.

2.1.4.2.2 Process Chemistry

The process chemistry of the GSA FGD system discussed here is limited to a listing of the primary and secondary reactions.

The following primary reactions take place in suspended solids containing lime:

$$Ca(OH)_2\ (aq) + SO_2\ (aq) \longrightarrow CaSO_3 \cdot \tfrac{1}{2}\ H_2O(s) + \tfrac{1}{2}\ H_2O$$

$$Ca(OH)_2\ (aq) + SO_3\ (aq) + H_2O(l) \longrightarrow CaSO_4 \cdot 2\ H_2O(s)$$

In addition to the primary reactions, the following secondary reactions also take place:

$$Ca(OH)_2\ (aq) + 2\ HCl\ (aq) + 4\ H_2O(l) \longrightarrow CaCl_2 \cdot 6\ H_2O(s)$$

$$Ca(OH)_2\ (aq) + CO_2\ (aq) \longrightarrow CaCO_3(s) + H_2O(l)$$

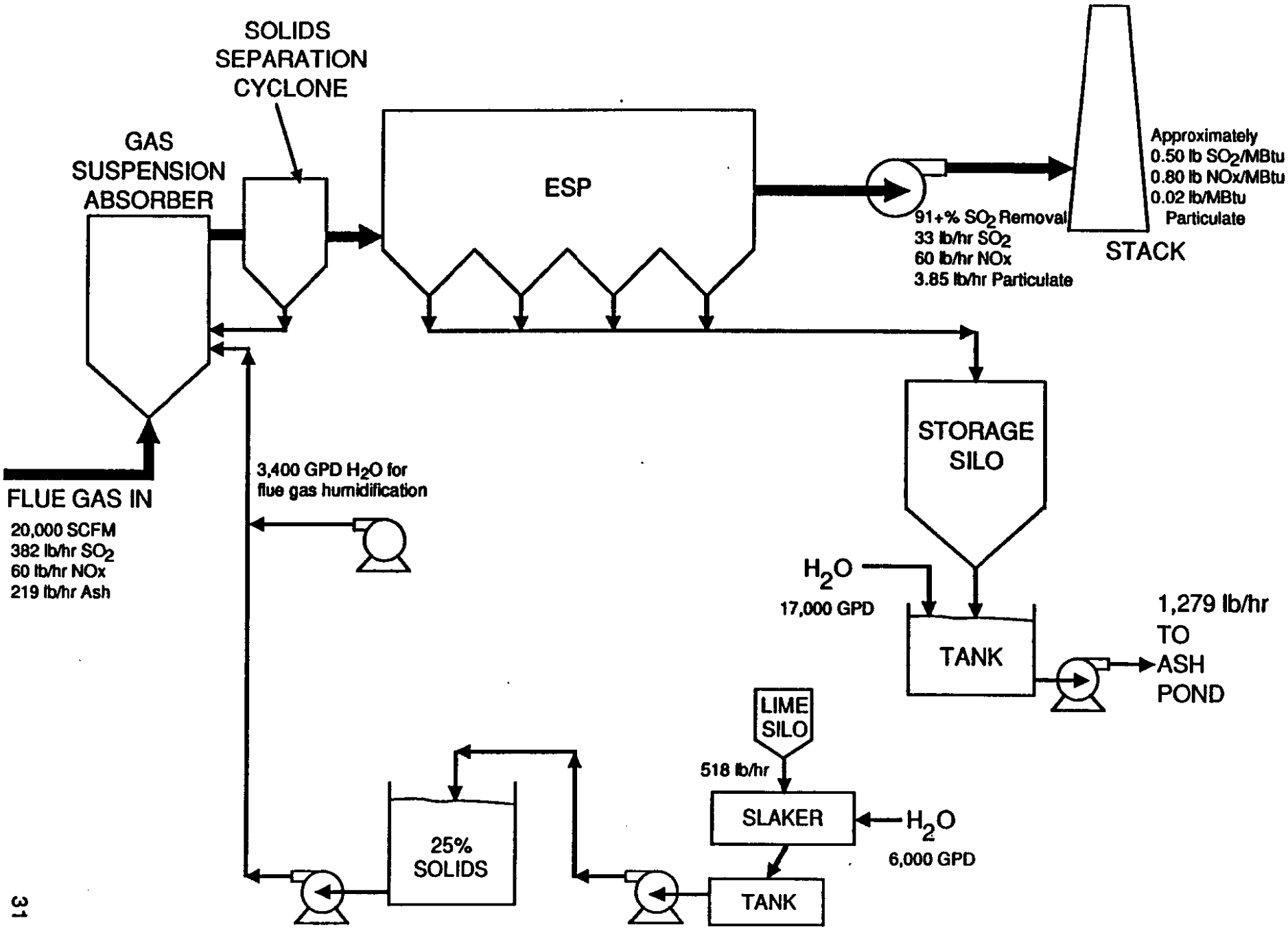
$$CaSO_3\ (aq) \cdot \tfrac{1}{2}\ H_2O + \tfrac{1}{2}\ O_2\ (aq) + 3\tfrac{1}{2}\ H_2O(l) \longrightarrow CaSO_4 \cdot H_2O(s)$$

2.1.4.3 Project Source Terms

This subsection characterizes the resource requirements and environmental residual associated with the GSA demonstration project.

2.1.4.3.1 Resource Requirements

Project resource requirements include energy, land, materials and labor. Figure 2-15 shows the expected continuous load material flow for AirPol's GSA process. The materials used for the GSA



AIRPOL'S GSA UNIT MATERIAL FLOW DIAGRAM
Figure 2-15

process and TVA's existing SD/ESP scrubber process are identical. However, the design of the GSA allows it to recycle 99% solids. The SD/ESP is limited to a maximum of 75% solids recycing. Therefore, the GSA may consume less reagent.

2.1.4.3.1.1 Energy Requirements

Energy requirements for the GSA unit are limited to electricity which will be obtained from the power plant. Table 2-4 below shows an estimate of power consumption by the GSA unit.

2.1.4.3.1.2 Land Requirements

No additional lands outside the TVA Shawnee Steam Plant boundaries will be required for the GSA unit. The unit is to be constructed on previously impacted land adjacent to the existing SD/ESP unit. The unit itself is relatively small (30ft. x 40ft. footprint) and will tie into existing line preparation, ash handling and particulate collection (ESP) systems thereby minimizing space requirements for installation. No additional ash pond or landfill capacity will be required for the GSA demonstration.

2.1.4.3.1.3 Material Requirements

The primary material requirements for the GSA process are lime and water, which are used in the preparation of a lime slurry that captures and neutralizes SO_2 entrained in flue gases generated from fossil fuel combustion. The GSA unit is expected to use less lime than the SD/ESP. Lime consumption for the GSA process is expected to be approximately 518 lbs/hr while water is consumed at the rate of 26,400 GPD. Of the 26,400 GPD water consumed, 6,000 GPD will go to make up the lime slurry, 3,400 GPD will be used to humidify flue gas, and the remaining 17,000 GPD will be used to dilute any solids from the process which are not recycled. This sluice will then be pumped to an existing ash pond.

Table 2-4
ESTIMATE OF GSA POWER CONSUMPTION (APPROXIMATE)

Estimate of Power Consumption (Approximate)		Installed
Fan Power 10% False Air, On Shaft:	212 hp max.	255 hp
Compressed Air 215 lbs/h 100 psi:	10 hp nom.	37 hp
Auxiliary Motors Approx.:	18 hp nom.	47 hp
Heaters:	3 hp nom.	9 hp

2.1.4.3.1.4 Labor Requirements

Labor will be required to construct the GSA demonstration unit. Onsite construction management will consist of a construction contractor and a field engineer from AirPol. AirPol's field engineer will provide coordination with TVA plant personnel. Labor for the installation will be drawn from the local labor pool and its size is not expected to exceed 12 workers. The construction phase of the project is expected to be less than 6 months.

2.1.4.3.2 Environmental Residuals

The significant waste discharge streams from the proposed GSA unit include stack emissions and a solid waste product consisting of spent sorbent and a small amount of flyash. TVA's unit 9 will be supplying the flue gas during the GSA system demonstration and has been on line since July 19, 1955. The STF's air emission profile for the testing of the GSA unit is expected to parallel that of the SD/ESP during its medium-to-high and high sulfur test phases. The GSA unit is expected to perform at a greater than 90% SO_2 removal efficiency. This level of performance will result in SO_2 emissions from the STF stack of approximately 0.50 lbs SO_2/MBtu.* The current air quality permit calls for sulfur dioxide emissions from unit 9 not to exceed 8.0 lbs/MBtu when being operated for the purpose of generating high SO_2 content flue gasses for the use in any experimental SO_2 removal system. The average SO_2 emissions for Shawnee unit 9 for the period between October 31, 1989 and October 31, 1990 were 4.93 lbs/MBtu. Whenever an SO_2 scrubber system is not in use with this unit, the SO_2 emission limit is 1.2 lbs/MBtu (see Appendix B for Air Quality Permit).

* Note: This calculation was based on the use of Pyro coal at 20,000 scfm at scrubber inlet and 90% SO_2 removal efficiency.

The GSA demonstration will take advantage of the existing solid waste disposal method and associated equipment currently in use at the STF. The GSA process will recycle 99% of the solids collected by the GSA unit. Any solids that are not recycled will be diluted to approximately 10% solids content before being pumped to an existing ash pond for ultimate disposal. The use of the GSA may result in a lower quantity of solid waste being generated. The expected chemical composition of the GSA solid waste is given in Table 2-5. The solid waste material is expected to be primarily calcium-based salts with an additional flyash component.

Samples of a similar by-product material generated when using the 10-MW SD/ESP unit to clean flue gas generated from medium-sulfur coal have been recently tested. All samples tested have fallen within the EPA boundaries for defining non-hazardous waste when using the EP toxicity test. (6)

The test conditions during which these samples were taken are shown in Table 2-6. All of these test conditions are representative of actual run conditions expected for a full-scale SD/ESP application. Test No. 4-B-28 reflects the standard operating conditions of the SD/ESP and should be considered the baseline case. The results of the EP toxicity procedures are shown in Table 2-7 where the concentration of the various components is given for each test sample. A comparison of these results with the drinking water standard (DWS) and the allowed level for these components (100*DWS) is shown in Table 2-8. (7)

2.1.4.4 Potential EHSS Receptors

The environmental, health, safety, and socioeconomic (EHSS) features which the GSA project could impact include air quality,

Table 2-5
THE EXPECTED CHEMICAL COMPOSITION OF THE GSA SOLID WASTE BY-PRODUCT

$CASO_3$ $1/3H_2O$	57%
$CaSO_4$	7.5%
$CaCO_3$	18%
$Ca(OH_2)$	3%
$CaCl_2$	3.5%
H_2O +	----
Fly Ash	4%
pH, s.u.	12

Source:
FAX #12012886441 from AirPol, May 8, 1990

Table 2-6
TEST CONDITIONS FOR SD/ESP WASTE SAMPLING

TEST NUMBER	DATE RUN	INLET FLUE GAS TEMPERATURE, °F	APPROACH-TO-SATURATION TEMPERATURE, °F	LIME STOICHIOMETRY MOLES $Ca(OH)_2$/ MOLE INLET SO_2
4-B-01	5/27	320	28	1.3
4-B-11	7/10	320	28	1.0
4-B-27	6/10	290	18	1.6
4-B-28*	6/18	320	18	1.3
4-C-01	7/28	320	20	1.3

* Test No. 4-B-28 Reflects Standard Operating Conditions at the SD/ESP Unit and Should Be Considered the Baseline Case.

Source:
Tennessee Valley Authority, "Characterization of 10-MW Spray Dryer/Electrostatic Precipitator By-Product (Medium-Sulfur Coal Testing) Final Report", 1989

Table 2-7
EP TOXICITY TEST RESULTS FROM TESTS ON SD/ESP WASTE SAMPLES

TEST NO.	COMPONENT CONCENTRATION, ppb							
	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
4-B-01	<100	940	29	<50	<50	<2	<100	<10
4-B-11	<100	270	20	<50	150	3.2	<100	<10
4-B-27	<100	940	21	<50	<50	<2	<100	<10
4-B-28*	<100	870	14	<50	<50	<2	<100	<10
4-C-01	<100	670	18	<50	160	0.3	<100	<10

* Test No. 4-B-28 Reflects Standard Operating Conditions at the SD/ESP Unit and Should Be Considered the Baseline Case.

Source:
Tennessee Valley Authority, "Characterization of 10-MW Spray Dryer/Electrostatic Precipitator By-Product (Medium-Sulfur Coal Testing) Final Report", 1989

Table 2-8
COMPARISON OF SD/ESP WASTE EP TOXICITY TEST RESULTS WITH THE DRINKING STANDARDS (DWS) AND ALLOWED LEVELS [a]

METAL	COMPONENT CONCENTRATION, ppb			
	DWS	DWS x 100 (ALLOWED LEVEL)	PHASE IV B SAMPLE RESULTS	
			AVERAGE	MAXIMUM
As	50	5,000	<100	100
Ba	100	10,000	738	940
Cd	10	1,000	20	30
Cr	50	5,000	<50	50
Pb	50	5,000	92	160
Hg	2	200	2	3
Se	10	1,000	<100	100
Ag	50	5,000	10	10

[a] GAI Consultants, Inc., "Coal Ash Disposal Manual", Electric Power Research Institute, Publication CS-2049, October 1981

Source:
Tennessee Valley Authority, "Characterization of 10-MW Spray Dryer/Electrostatic Precipitator By-Product (Medium-Sulfur Coal Testing) Final Report", 1989

Section 3.0

EXISTING ENVIRONMENT

3.0 EXISTING ENVIRONMENT

This section describes the existing environment within and around the Shawnee Steam Plant.

3.1 Atmospheric Resources

3.1.1 Local Climate

Paducah, Kentucky exhibits a temperate climate with a thirty-year normal annual average temperature of 57.2°F, a monthly average minimum of 24.4°F, and a monthly average maximum of 88.8°F for the years 1951-1980. Precipitation in the area is generally well distributed throughout the year without any one month or season being particularly wet. However, 1989 was an exception -- February's precipitation was 13.33 inches, versus a 30-year normal of 3.39 inches for the month. June and July of 1989 also exhibited heavier than normal rainfall. Table 3-1 shows the temperature and the precipitation data for the Paducah vicinity.

Wind roses for the Shawnee Fossil Plant indicate that in 1987 the predominant wind direction for January and April was northerly (see Figure 3-1). During July and October, the winds at the plant site were mostly southerly (Figure 3-2).

3.1.2 Ambient Air Quality

The last available Ambient Air Quality Data for the Shawnee Power Plant indicates no exceedances of National Ambient Air Quality Standards (NAAQS) have occurred for SO_2 (1988), TSP (1986), or NO_2 (1980). Data for 1989 for the city of Paducah also show no exceedances for the above parameters. Table 3-2 shows the latest available data for the Shawnee Power Plant and for Paducah, Kentucky. Figure 3-3 compares the available monitoring data from Shawnee versus the NAAQS.

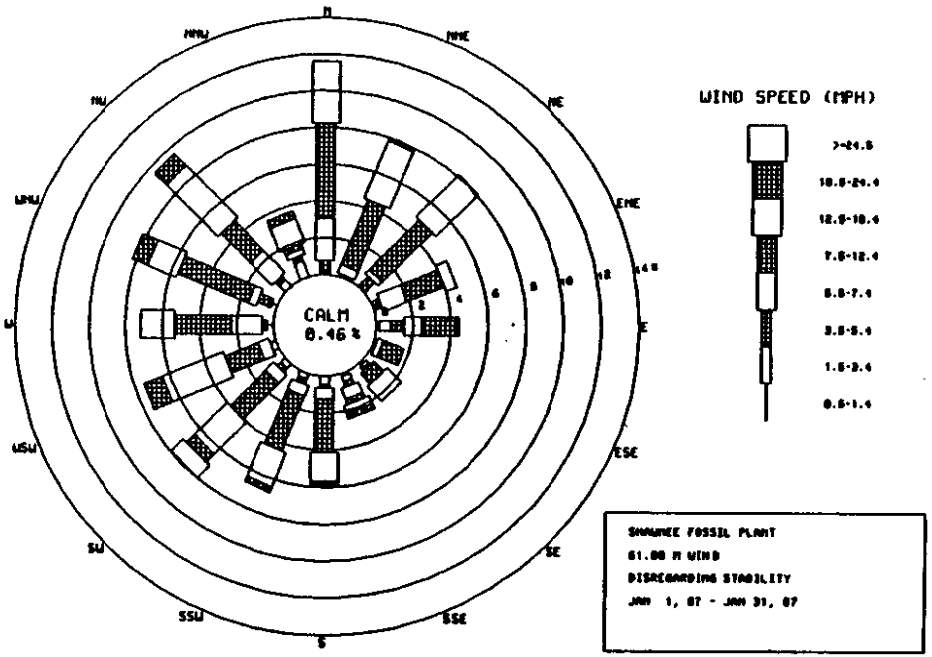
Table 3-1
CLIMATE DATA FOR PADUCAH, KENTUCKY NATIONAL WEATHER SERVICE STATION

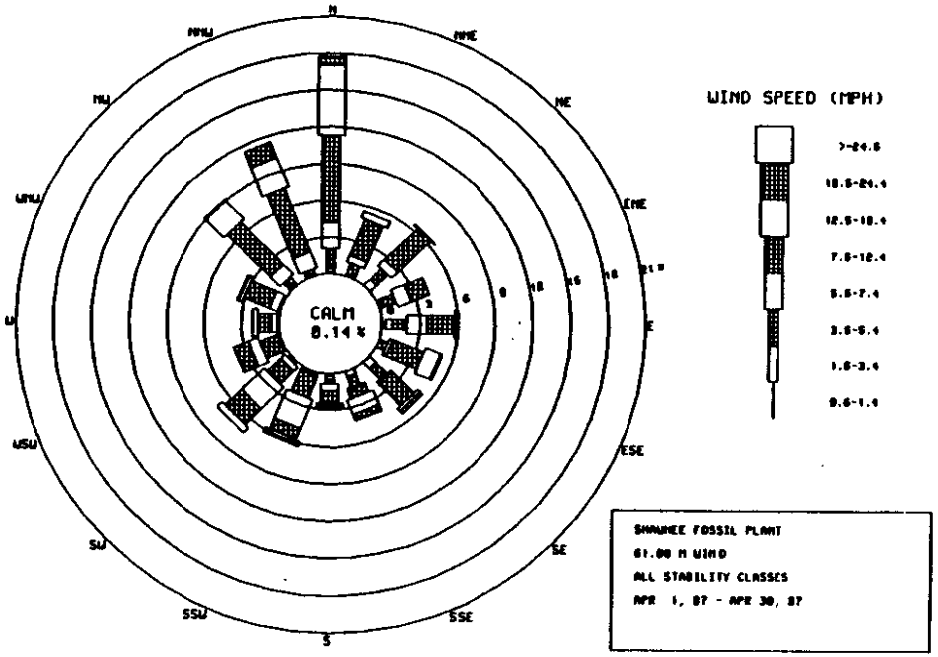
Climate Data for Paducah, Kentucky National Weather Service Station*

	Temperature (degrees F)				Precipitation (inches)		
	1989 Averages		1951-1980 Normals		1989	1951-1980	No. days in 1989
Month	Max.	Min.	Max.	Min.	Totals	Normals	1/2 inch or more
January	51.2	31.6	42.1	24.4	5.31	3.67	4
February	40.5	25.0	46.6	27.8	13.33	3.39	6
March	58.7	37.5	56.1	36.4	5.36	4.96	4
April	69.4	45.2	68.6	47.5	2.55	4.57	1
May	76.5	52.6	77.3	56.4	2.33	4.65	1
June	83.5	63.7	85.7	64.8	9.20	4.45	5
July	87.8	68.8	88.8	68.7	7.07	3.69	4
August	88.4	67.0	87.7	66.5	1.80	3.22	2
September	79.5	59.0	81.4	59.2	2.64	3.49	3
October	73.3	46.4	70.8	46.7	3.48	2.60	1
November	59.5	37.7	56.7	36.6	2.59	4.04	2
December	37.4	16.8	46.4	29.2	1.78	4.16	2

Annual Average Temperature: 1989 = 56.6, 1951-1980 normal = 57.2

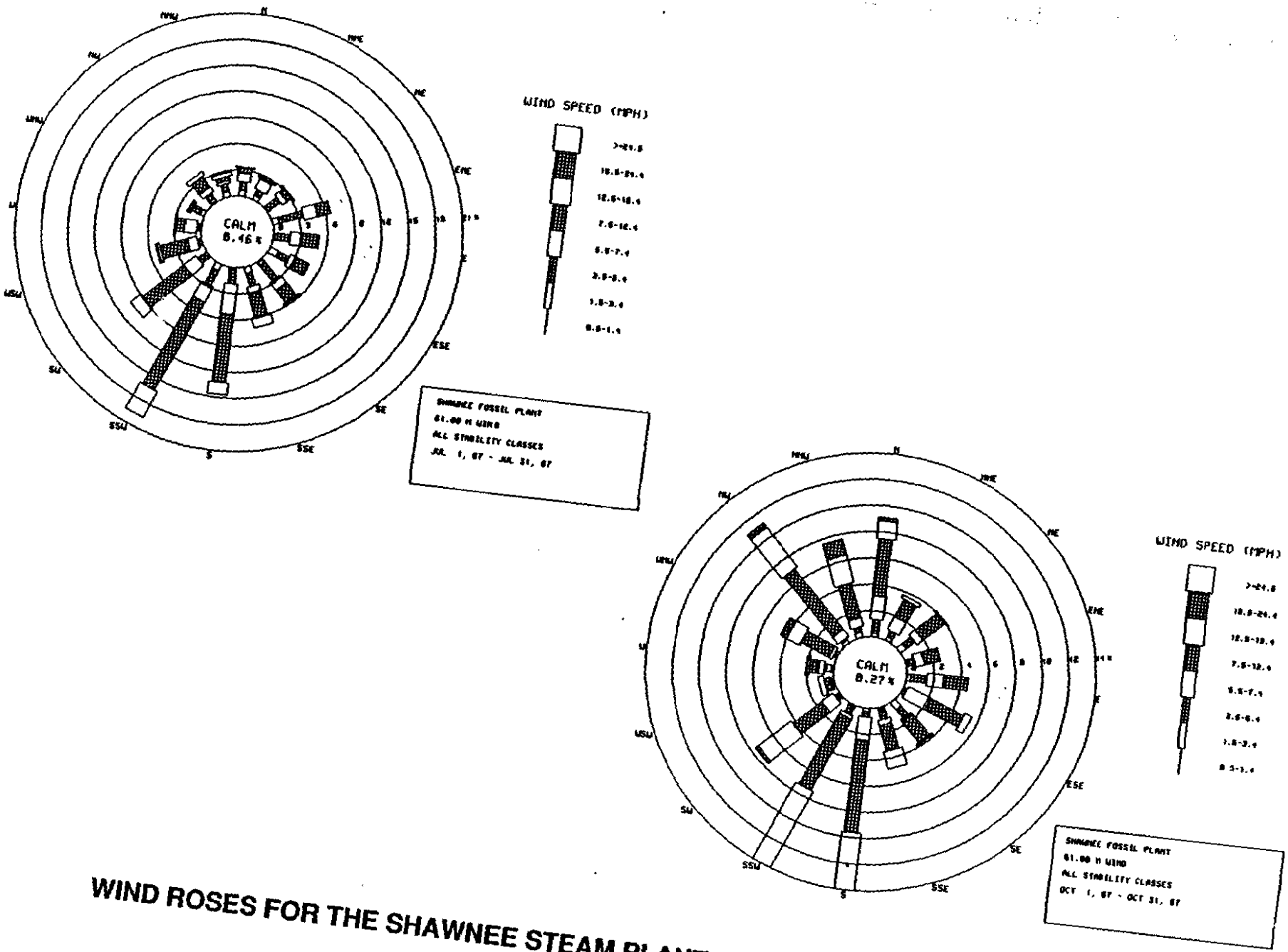
* Local climatological data summaries for Paducah, Kentucky - 1988 annual summary and 1989 monthly summaries - from National Climatic Data Center, Asheville, North Carolina.





WIND ROSES FOR THE SHAWNEE STEAM PLANT - JANUARY AND APRIL 1987

Figure 3-1



WIND ROSES FOR THE SHAWNEE STEAM PLANT - JULY AND OCTOBER 1987

Figure 3-2

Table 3-2
LATEST AVAILABLE AMBIENT AIR QUALITY DATA FOR SHAWNEE STEAM PLANT AND PADUCAH, KENTUCKY

Last Available Ambient Air Quality Data for Shawnee Power Plant and Paducah, Kentucky - Sulfur Dioxide, Total Suspended Particulates, and Nitrogen Dioxide (Units = micrograms per cubic meter) *

A. Shawnee Power Plant

Sulfur Dioxide (1988)	
3-hour 2nd High	368
Standard	1,300
24-hour 2nd High	97
Standard	365
Annual Ave. (Arith.)	21
Standard	80

Total Suspended Particulates (1986)	
24-hour 2nd High	87
Standard	150
Annual Arithmetic Mean	50
Annual Geometric Mean	47
Standard (Geom.)	50

Nitrogen Dioxide (1980)	
Annual Ave. (Arith.)	17
Standard	100

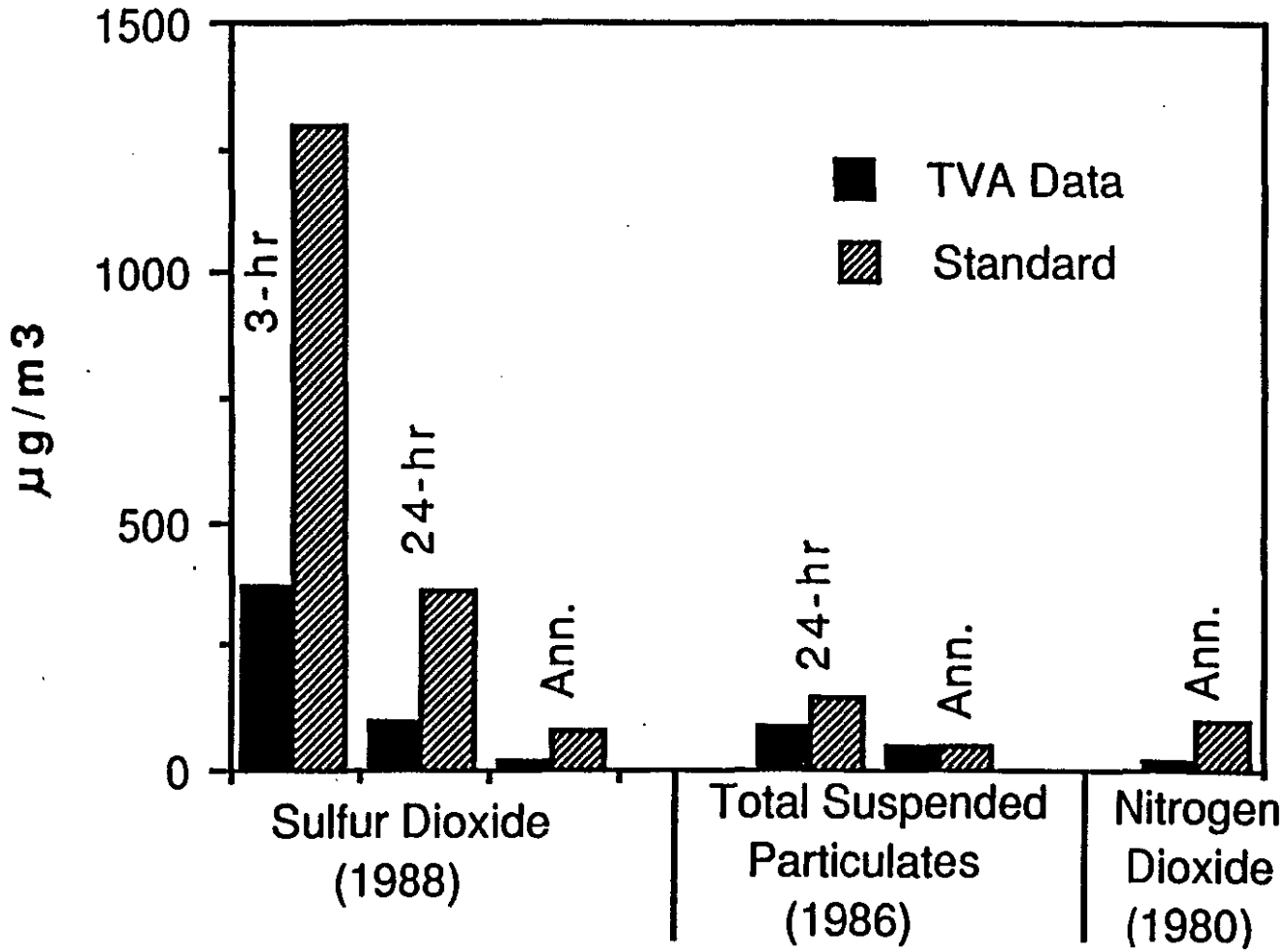
B. Paducah.

Sulfur Dioxide (1989)	
3-hour 2nd High	144
Standard	1,300
24-hour 2nd High	63
Standard	365
Annual Ave. (Arith.)	10
Standard	80

Total Suspended Particulates (1989)	
24-hour 2nd High	114
Standard	150
Annual Mean (Arith.)	54
Standard (Geom.)	50

Nitrogen Dioxide (1989)	
Annual Ave. (Arith.)	26
Standard	100

* Data obtained from TVA annual air quality data summaries and the State of Kentucky annual air quality monitoring data summary for 1989.



SHAWNEE MONITORING DATA VS. NATIONAL AMBIENT AIR QUALITY STANDARDS

Figure 3-3

3.2 Land Resources

3.2.1 Land Use

Land use in the immediate vicinity of the Shawnee Steam Plant reservation consists mainly of sparsely settled farmland, low-density rural residential development, a Department of Energy facility, and the West Kentucky State Wildlife Management Area (WKSWMA). Parts of the WKSWMA are managed for hunting, part is a wildlife refuge, and another portion is utilized as a field trial area. (8)

3.2.2 Prime Farmland

Soil surveys conducted at the Shawnee Steam Plant reservation, on land within the WKSWMA, indicated a number of soils classified as prime farmland and land of State-wide importance. Approximately 53% of McCraken County is farmland. (9) All lands which could be affected by the project are within the steam plant boundary and have been previously disturbed.

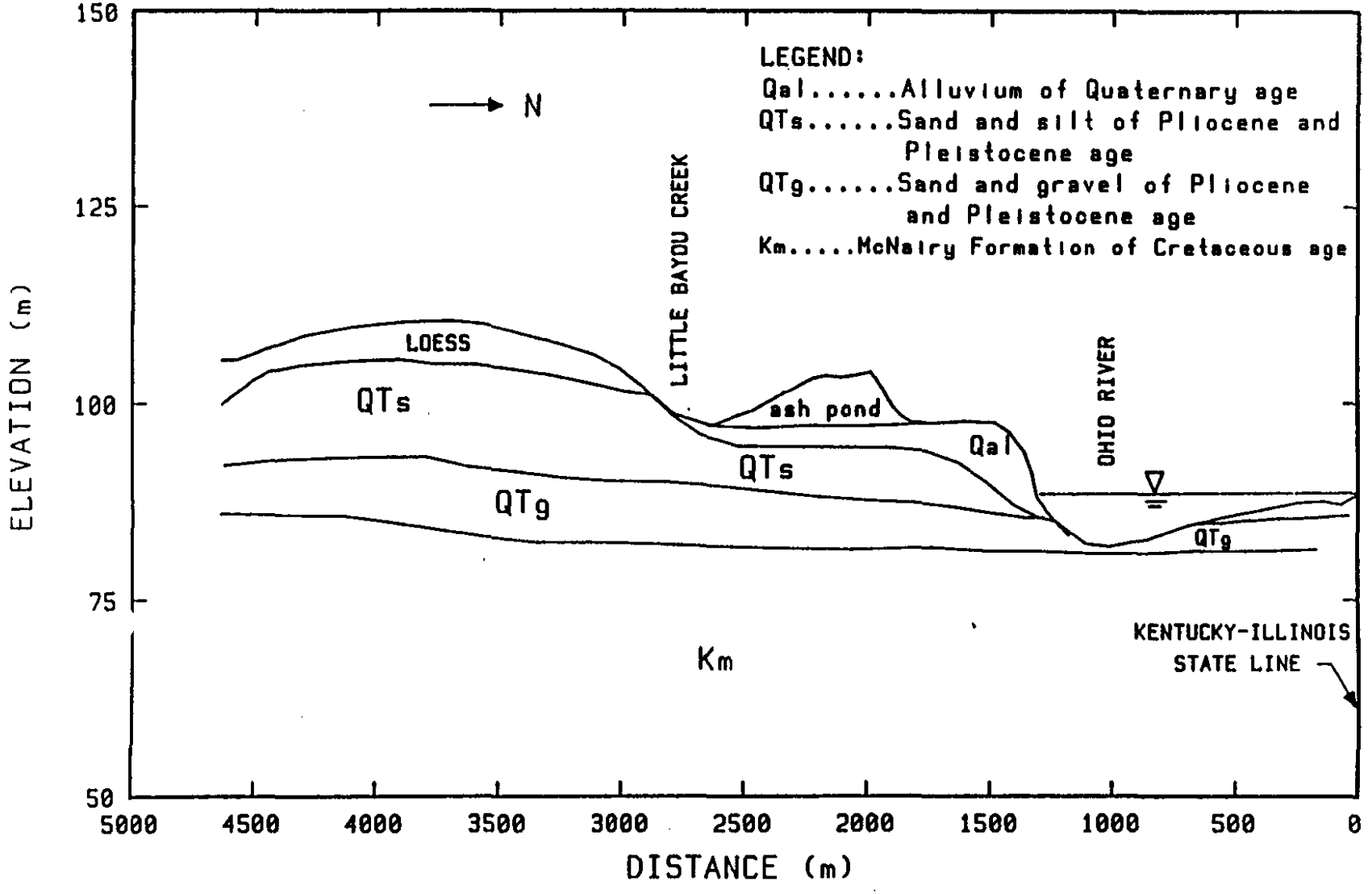
3.2.3 Geology

Soil boring logs show that the surface of the site is blanketed by loess. This material consists of fine silts and silty clays with streaks of brown sand to a maximum thickness of 13M. (10) Beneath the loess and alluvial desposits are Plio-Pleistocene sands, clays, and gravels. The maximum thickness of these deposits is approximately 87M. (11) A generalized geologic section of the Shawnee site is shown in Figure 3-4.

3.3 Water Resources

3.3.1 Surface Water Quality

The Ohio River from the Shawnee Steam Plant to its mouth is currently classified by the Kentucky Division of Water Quality (KDWQ) for primary and secondary contact recreation, and domestic water supply. (12)



Source:
Tennessee Valley Authority, "Shawnee Groundwater Assessment Phase I", 1989

GENERALIZED GEOLOGIC SECTION THROUGH SHAWNEE
Figure 3-4

An environmental assessment conducted by TVA at the Shawnee Steam Plant site in 1984 reported that the stream segment in the vicinity of the Shawnee Steam Plant was designated by KDWQ as water quality limited due primarily to lower water quality caused by non-industrial discharges (sewage overflow, urban runoff). Recent conversations with KDWQ confirm that this designation is still in effect. (13)

Approximately 1.5 billion gallons of water are discharged to the Ohio River daily from the operation of the Shawnee Steam Plant. Of this total 17,000 gallons per day are expected to be generated from the GSA operations. This constitutes less than 0.001% of the total discharge and, therefore, should have little or no impact on the surface water quality.

Table 3-3 shows concentrations of several water quality parameters in the Ohio River near the site together with the respective EPA water quality criteria for the protection of aquatic life.

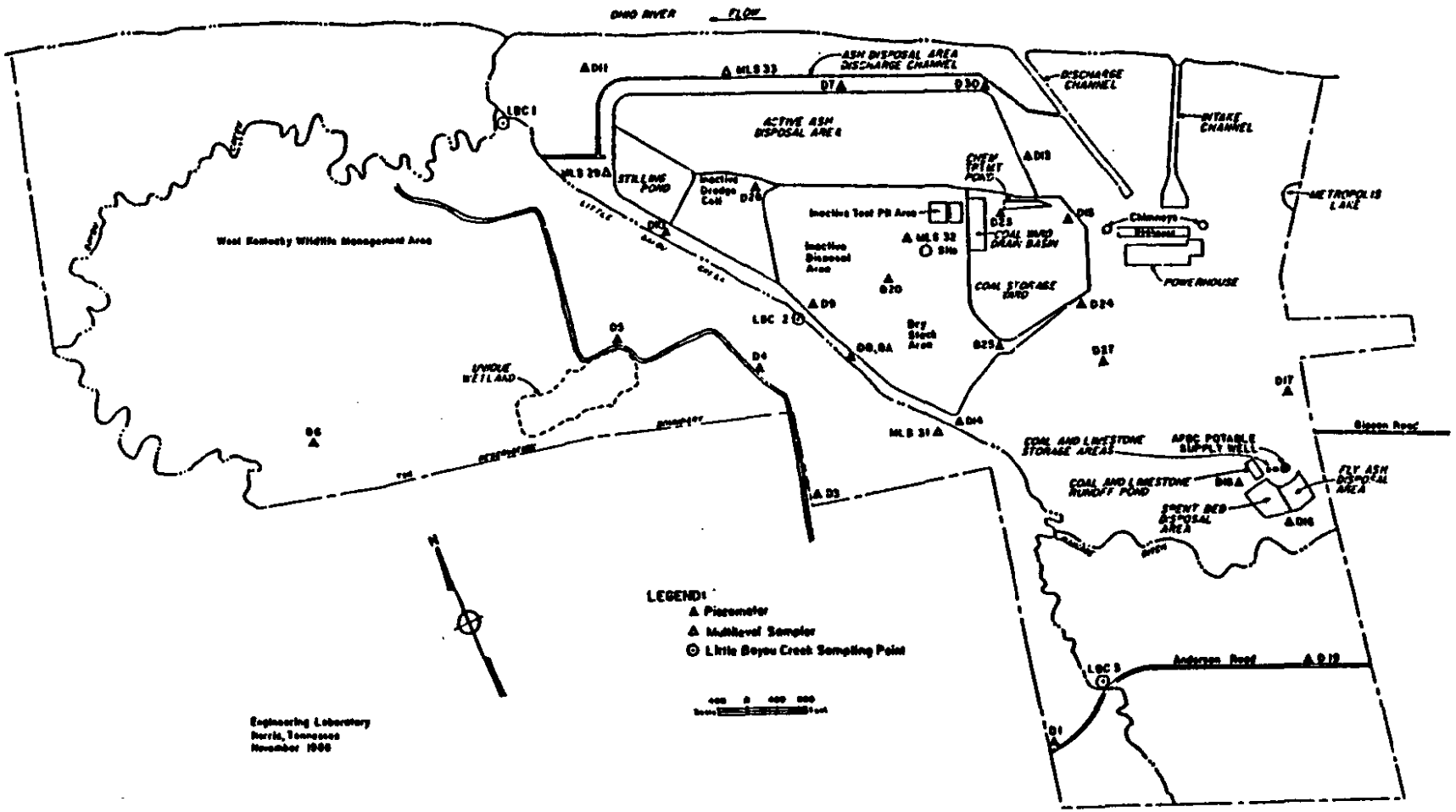
3.3.2 Ground Water Quality

The Shawnee Steam Plant site is located over a major usable aquifer and has recently been the subject of an extensive groundwater assessment by TVA. The study indicated this aquifer is recharged by local precipitation which averages about 46 inches/year. The study stated that the general direction of regional groundwater flow is in a northerly direction across the plant site toward the Ohio River. Water level data gathered in the assessment indicated the existence of a groundwater mound beneath the 180-acre active ash pond and extending into the inactive ash disposal area (see Figure 3-5, Groundwater Assessment Site Map). The mound contacts subsurface fly ash in a portion ot the inactive ash pond and from this point flows radially towards the Ohio River, the ash pond discharge channel, and Little Bayou Creek (LBC).

Table 3-3
AMBIENT RIVER WATER QUALITY NEAR SHAWNEE STEAM PLANT AND EPA CRITERIA FOR AQUATIC LIFE

PARAMETER (mg/l)	AMBIENT RIVER WATER QUALITY [a]			AQUATIC LIFE CRITERIA		
	MAXIMUM	MINIMUM	MEAN	4-DAY AVG.[b,c]	1-HR. AVG.[b,d]	INST. MAX.[c]
Arsenic	10.6	<0.5	1.9	190	360	50
Chromium	<25	<10	<13.8	----	----	100
Cadmium	<5	<1	<2.6	0.9 [f]	3.0 [f]	12.0
Copper	10	2	6.5	9.5 [f]	14 [f]	----
Iron	1200	320	720	----	----	1000 [b,e]
Lead	60	<10	21	2.3 [f]	59 [f]	----
Manganese	120	24	67	----	----	----
Mercury	0.3	<0.1	<0.14	0.012	2.4	0.2
Nickel	<20	<2	<10.5	79 [f]	1527 [f]	----
Selenium	2	<1	<1.5	5	20	----
Silver	<5	<2	<2.75	----	----	2.6 [b,f]
Zinc	15	6	10	86 [f]	95 [f]	47
Cyanide	0.007	<0.001	<0.001	5.2	22	5
Phenols	4	<2	2.6	----	----	5
Ammonia-N	0.11	<0.01	0.05	----	----	0.05
Suspended Solids	29	3	12.5	----	----	----
Sulfate	29	9	16.6	----	----	----
Total Hardness	108	58	78	----	----	----
BOD	2.0	0.9	1.5	----	----	----
pH [g]				----	----	6.0 - 9.0

[a] Data from the "Quality Monitor", the Ohio River Valley Water Sanitation Commission at Paducah MP6 Sample Station from October 1988 through September 1989.
[b] EPA "Quality Criteria for Water 1986"
[c] Four-day average concentration not to be exceeded more than once every three years on the average.
[d] One-hour average concentration not to be exceeded more than once every three years on the average.
[e] Commonwealth of Kentucky, Warmwater Aquatic Life Criteria, 401 KAR 5:031, Surface Water Standards
[f] Values calculated for 78 mg/l hardness.
[g] TVA data taken at the Shawnee intake, Ohio River Mile 945, May 31, 1990



Source:
Tennessee Valley Authority, "Shawnee Groundwater Assessment Phase I", 1989

SHAWNEE GROUNDWATER ASSESSMENT SITE MAP
Figure 3-5

Water quality data from the monitoring wells indicated that there are some groundwater impacts associated with the groundwater being in contact with the waste disposal areas for coal combustion wastes. "Sampling of LBC showed that the creek is intercepting seepage from the waste disposal areas, but no metals appeared in high concentrations. Monitoring wells within the WKWMA wildlife management area across LBC from the waste disposal areas did not show elevated concentrations of coal ash constituents indicating that the creek may be an hydraulic boundary between these two areas."

The assessment states that, "The extent of groundwater impacts appear to be limited to the immediate vicinity of the waste disposal areas. Sampling of private wells surrounding the site showed no evidence of being impacted." (14)

3.4 Ecological Resources (15)

3.4.1 Aquatic

Aquatic environments in the vicinity of the Shawnee site include the Ohio River, Bayou Creek, Little Bayou Creek, swamps near lower Bayou Creek, and Metropolis Lake. Metropolis Lake is located east of the power plant site and is part of the Kentucky Heritage Program. The Ohio River is regulated by small dams which function primarily during low-water conditions. Water depth varies considerably as a result of large influxes of water from the large drainage area, limiting development of good shoreline habitat. The phytoplankton community in the Ohio River is frequently limited by high river flows and turbid water. Typical seasonal progression from diatoms to green algae to blue-green algae was observed in 1978 TVA studies.

Benthic macroinvertebrates do not extensively colonize areas in the Ohio River dominated by deep sand. Cobble and gravel areas, as well as sandy areas closest to shore, are more productive. Qualitative TVA

surveys during 1980 indicated that a substantial mussel population exists upstream from the plant and near the steam plant discharge channel for an undetermined distance downstream. TVA rotenone surveys in the mainstream Ohio River above (Ohio River Mile (ORM) 930.8) and below (ORM 962.6) Shawnee (ORM 946) identified 37 fish species representing 14 families.

Little Bayou and Bayou Creeks are lowland streams of first and second order, respectively, which combine and flow into the Ohio River at mile 948. Except for localized areas, both creeks have riffle-pool-run development with undercut banks and overhanging limbs.

Studies conducted by Battelle Laboratories in 1979 and by TVA in 1980 show both creeks support a relatively large number of macroinvertebrate and fish species with many of these represented by large populations. A diverse fish fauna comprised of forage and sport fishes characteristic of lowland streams inhabits both creeks, and there is evidence of bank fishing in the lower portion of Bayou Creek. Both creeks and the swamp areas provide suitable spawning and/or nursery areas for many species of fish, including longear sunfish, bluegill, green sunfish, bass, and several minnows and darters.

3.4.2 Terrestrial

Principal upland plant communities of the Shawnee Reservation include row crop fields, old fields, and bottomland and upland hardwood forests. These plant communities are not present on the proposed site for the GSA.

3.4.3 Threatened and Endangered Species

3.4.3.1 Aquatic

Commercial and TVA-commissioned sampling within six miles of the Shawnee Steam Plant between June and August 1980 produced

specimens of 28 fresh-water mussel species, including the pink mucket pearly mussel (Lampsilis orbiculata) and the orange-footed pearly mussel (Plethobasus cooperianus), both listed as endangered by the U.S. Fish and Wildlife Service (USFWS). These species were found in a mussel bed one mile upstream from the I-24 bridge (six miles upstream from the Shawnee Steam Plant), and there is a possiblity they occur in the vicinity of the Shawnee site. No specimens of the tuberculed-blossom pearly mussel (Epioblasma torulosa torulosa) were found. Additionally, the fat pocketbook (Potamilus capax) has been identified by the USFWS as being present, but endangered, in the Ohio River. (16)

Recent discussions between representatives of the Kentucky Nature Preserves Commission and DOE identified four rare or threatened species of fish present in Metropolis Lake: chain pickerel (rare), cyprus minnow (threatened), spotted sunfish (threatened), and the taillight shiner (threatened). (17)

3.4.3.2 Terrestrial

No Federal- or State-listed terrestrial threatened or endangered species or species proposed for listing are known to have been found at the site of the proposed AFBC add-on unit. Several listed species, however, are known to have been found in the adjacent WKSWMA. These include the Federal-listed endangered peregrine falcon (Falco peregrinus); the State-listed endangered Bell's vireo (Vireo bellii); the State-listed threatened hooded merganser (Lophodytes cucullatus); and the downy cottonwood (Populus heterophylla). Several species of undetermined status, including the great blue heron (Ardea herodias), great egret (Casmerodius albus), and fish crow (Corvus ossifragus), are also in the area.

3.5 Socioeconomic Resources

In 1980, Paducah's population was approximately 29,000 while McCracken County had a population of approximately 61,000. Because of the GSA project's size, no employees are expected to relocate in the Paducah area to work on the project.

3.6 Aesthetic/Cultural Resources

3.6.1 Archaeological Resources

A cultural resource survey was conducted at Shawnee in 1980 at the site of the proposed 200-MW AFBC plant. ("Archaeological Survey and Evaluation for the Shawnee 200-MW AFBC Plant, McCracken County, Kentucky", by Brian M. Butler, et. al., 1981. On file, TVA's Cultural Resources Program.) Four potentially significant prehistoric sites were noted. The proposed GSA site was evaluated for cultural resources in 1984 for a proposed AFBC add-on. It was determined that prior disturbance had altered this site to such an extent that cultural resource field surveys were not warranted. If any archaeological material is encountered during construction, work will cease until a field evaluation has been conducted by TVA's Cultural Resource Program. (18)

3.6.2 Historical Resources

The Cultural Resources Program determined in 1984 that a structure demolition in the late 1940's and terrain alterations in the 1960's preclude the possibility of adverse project impact to any significant historical resource on this site.

3.6.3 Native American Resources

No Native American groups have cultural ties to the area. There are no known descendants of historic or prehistoric Native American groups that may have resided in the area, and no prehistoric or historic Native American cultural or sacred sites are present.

3.6.4 Scenic or Visual Resources

The proposed GSA site will be totally contained within the Shawnee Steam Plant boundary and will be of such dimensions so as not to affect any offsite scenic or visual resource.

3.7 Energy and Material Resources

The material resources used in this project are expected to be essentially the same as those used for the existing SD/ESP system. Refer to Section 2.1.4.3, "Project Source Terms".

Section 4.0

CONSEQUENCES OF THE PROJECT

4.0 CONSEQUENCES OF THE PROJECT

4.1 Atmospheric Impacts

4.1.1 Conventional Pollutants

The primary objective for the installation of the GSA system at the TVA's Scrubber Test Facility is to demonstrate its ability to effectively remove sulfur dioxide (SO_2) from unconditioned flue gas. Raw flue gas will be provided to the STF from Shawnee's unit 9 which has been configured to divert 10 percent its total flue gas output to the STF for the purpose of testing experimental scrubber technologies. The GSA unit will be operated in lieu of TVA's existing spray dryer scrubber. GSA operation should not result in an increase in stack emissions of SO_2, NOx, or particulates since:

- o GSA's SO_2 removal efficiency (>91%) is expected to equal or exceed that of the existing spray dryer scrubber (90%)
- o Neither unit is designed to mitigate NOx emissions
- o Particulate emissions at the STF are controlled by an electrostatic precipitator (>98% efficient) downstream of the scrubber units

Table 4-1 compares the composition of the unconditioned flue gas from unit 9 at the STF inlet and the anticipated composition as it exits the STF stack when the GSA unit is in operation.

Table 4-1

Comparison of Flue Gas Composition from TVA's Shawnee Unit 9 with the Anticipated Composition of GSA Conditioned Flue Gas as it Exits the STF Stack

	Unconditioned Flue Gas form Shawnee Unit 9 at STF Inlet*	GSA Conditioned Flue Gas as it Exits STF Stack
SO_2	382 lb/hr	33 lb/hr (>91% Removal)
NOx	60 lb/hr	60 lb/hr (No Change)
Ash	219 lb/hr	3.85 lb/hr Particulate (>98% Removal)

* 2.84 Percent Sulfur Coal and 20,000 scfm

4.1.2 Other Potential Emissions

Only minor air quality impacts of a temporary nature are expected during the installation of the GSA unit at the STF. These impacts will be due to fugitive dust emissions and exhausts from construction equipment used during construction.

4.2 Land Impacts

Land impacts will be insignificant since no additional lands outside the TVA Shawnee Steam Plant boundaries will be required for the GSA unit and the unit is to be constructed on previously impacted land between an existing spray dryer building and an electrostatic precipitator located at the STF.

4.3 Water Quality and Solid Waste Impacts

The solid waste by-product resulting from the operation of the GSA unit is expected to have the same composition as the spray dryer waste by-product. In keeping with the existing practices, these non-recycled solids will be diluted with water to generate a slurry containing approximately 10 percent solids before being pumped to an existing ash pond for ultimate disposal. Changes in ash pond effluents as a result of the operation of the GSA are not expected.

4.4 Ecological Impacts

No adverse ecological impacts to either terrestrial or aquatic environments are expected from the GSA project. The GSA unit will be constructed on previously disturbed land located beyond the 500-year flood plain of the Ohio River. Effluent from its operation will constitute less than 0.001% of the total Shawnee Steam Plant waste water balance discharged to the Ohio River. Although wetlands are present within the broader confines of the Shawnee Steam Plant, the GSA unit will not be installed by nor will it discharge to any wetland or lake.

4.5 Socioeconomic Impacts

Because of the GSA project's size, no employees are expected to relocate in the Paducah area to work on the project. Labor for the installation will be drawn from the local labor post and its size should not exceed 12 workers.

4.6 Aesthetic / Cultural Resources Impacts

No impacts are expected. See Section 3.6 for complete discussion.

4.7 Material Resources

Unpon completion of a one-year testing period, the GSA is scheduled to be disconnected. Equipment and materials associated with the project will be utilized in other projects at the site wherever possible. (Note: Refer to Section 2.1.4.3.1.3 for primary material requirements for the GSA process.)

4.8 Transportation Requirements

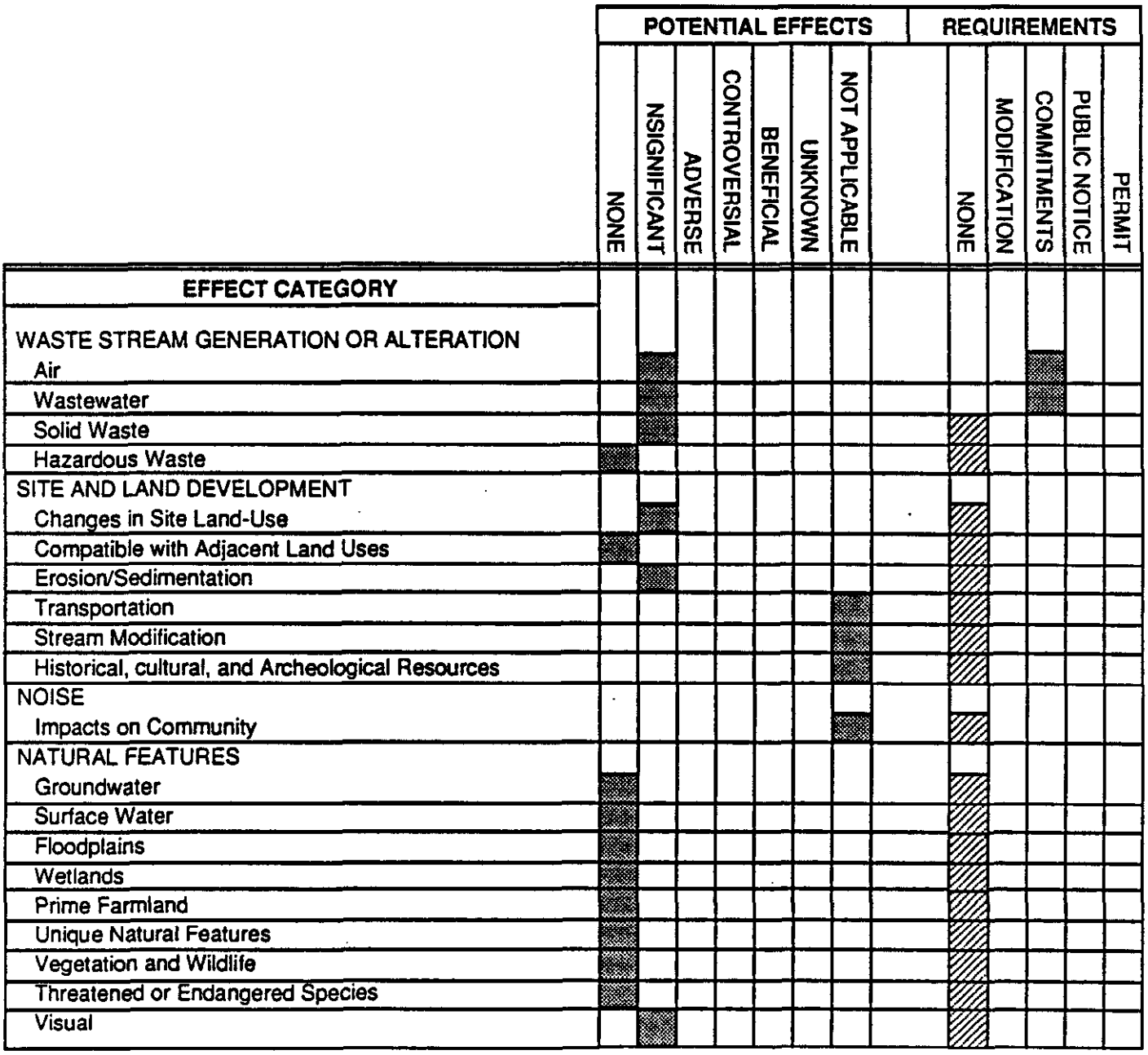
A minor increase in traffic volume offsite is expected during the construction period, primarily due to construction material deliveries and commuting workers. The increase in traffic is within the capacity of the local road network, and no reduction in the level of service being provided is anticipated.

4.9 Impact Summary

The majority of the potential additional environmental consequences resulting from the installation, operation and testing of the GSA can be categorized as insignificant because TVA's existing SD/ESP and AirPol's GSA process are essentially identical and the GSA is to replace the SD/ESP. However, two potential positive environmental impacts are identifiable: (1) the GSA may consume less lime than the existing system; (2) and may, therefore, generate less solid waste by-product. Table 4-2

summarizes the potential environmental effects and the required permit modifications necessary for the installation of the GSA unit at the TSF. Refer to Appendix A, "TVA's Environmental Decision Record", for the GSA scrubber installation at the Shawnee Steam Plant.

Table 4-2
SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS AND REQUIRED PERMIT MODIFICATIONS FOR THE GSA



Source: Tennessee Valley Authority Environmental Decision Record (EDR) for AirPol's Gas Suspension Absorption (GSA) Process

Section 5.0

REGULATORY COMPLIANCE

5.0 REGULATORY COMPLIANCE

This section describes the current permits and regulations governing plant operation. This section also addresses modifications to existing permits.

5.1 Regulations and Permit Requirements

TVA will be the host site for the demonstration of the GSA project. The GSA unit is to be installed within the STF area at TVA's Shawnee Steam Plant. TVA's unit 9 boiler is configured to supply either medium-to-high sulfur or high-sulfur flue gas to the STF. TVA currently has on file all the necessary permits for both the STF and the steam plant. Applicable sections of TVA's permits for air emissions, waste water discharges, and waste water permit modifications are included in Appendix B.

The Division for Air Quality of the Kentucky Natural Resources and Environmental Protection Cabinet has issued a permit to TVA for operation of units 1-10 at Shawnee with the following limits for each unit: 1,617 mmBtu/hr maximum heat input; particulate emissions shall not exceed 0.11 lb/mmBtu; and visible emissions shall not exceed 20% opacity. In addition, SO_2 emissions from units 1-8 and 10 are limited to 1.2 lbs/mmBtu. Unit 9 has been given a variance on the SO_2 emissions and is limited to 8.0 lbs/mmBtu while supplying flue gas for use in any experimental SO_2 removal system (see Appendix B). Kentucky requires TVA to monitor opacity and SO_2 emmisions for all units and to issue quarterly reports.

Non-recycled solids from the STF are diluted and pumped to an existing 180-acre ash pond. The ash pond effluent is then discharged to the steam plant's condenser cooling water (CCW) discharge channel which, in turn, discharges to the Ohio River. The Division of Water of the

Kentucky Natural Resources and Environmental Cabinet has issued NPDES Permit No. KY0004219 to TVA authorizing discharges from the Shawnee Steam Plant to the receiving waters of the Ohio River.

5.2 Anticipated Permit Modifications

Existing permits address the environmental parameters associated with testing experimental scrubber technologies at the STF. No modifications to the existing permits will be required beyond letters of notification to the State of Kentucky of TVA's intent to test the GSA technology (see Appendix A).

5.3 Other Required Permits

Construction permits for the installation of the GSA unit will be obtained from State and local authorities.

5.4 Floodplain/Wetlands

Flood Insurance Rate Maps (FIRM) provided by the Federal Emergency Management Agency (FEMA) for McCracken County, Kentucky,indicate that the GSA plant site and disposal areas are located outside the limits of the 100-year and 500-year floodplains (see Appendix C). The elevation of the GSA site is 347. Table 5-1 lists the pertinent flood elevation information for the portion of the Ohio River which flows along TVA's Shawnee Steam Plant. (17)

No wetlands are present on the proposed GSA site. However, wetlands are present within the broader confines of the Shawnee Steam Plant bounderies. Appendix C contains the applicable FIRM; National Wetlands Inventory; maps for the GSA site; and the Joppa, Illinois-Kentucky quadrangle map.

Table 5-1

100-YEAR AND 500-YEAR FLOOD ELEVATIONS AT TVA'S SHAWNEE STEAM PLANT SITE

OHIO RIVER MILE	FLOOD ELEVATIONS	
	100-YEAR	500-YEAR
945	334.6	338.5
946	334.3	338.2
947	334.0	337.8

Section 6.0

LIST OF PREPARERS AND PROFESSIONAL QUALIFICATIONS

6.0 LIST OF PREPARERS AND PROFESSIONAL QUALIFICATIONS

This EIV was principally compiled by Bruce A. Gold with input from environmental experts connected with TVA's Environmental Network.

Bruce A. Gold, Tennessee Valley Authority, Power Group, Environmental Specialist

Mr. Gold has been with TVA's Research & Development staff since 1978 and provides environmental support to R&D projects dealing with waste-to-energy and biomass utilization. He has recently been assigned to address environmental issues associated with the TVA Scrubber Test Facility.

TVA's Environmental Network Contributors:

Norris A. Nielsen, specialist: Meteorology & Climatology

J. Bennett Graham, specialist: Archeologist

John J. Jenkinson, specialist: Aquatic Ecology

Bill Redmond: TVA Natural Heritage Program Manager

Roger Thomas, specialist: Water Quality & Environmental Regulations

REFERENCES

REFERENCES

1. Kentucky Department for Environmental Protection, Division of Water. National Pollutant Discharge Elimination System Permit # KY0004210.

2. Ed Pushaver. Tennessee Valley Authority. Telephone conversation with Bruce Gold, TVA. May 18, 1990.

3. **Source for Section 2.1.3:** Tennessee Valley Authority. 10-MW Spray Dryer/ESP Pilot Plant Test Program High-Sulfur Coal Test Phase (Phase III) Final Report. 1988.

4. **Source for Sections 2.1.4 and 2.1.4.1:** AirPol, Inc. "10-MW Gas Suspension Absorbtion Demonstration Statement of Work." 1989.

5. **Source for Section 2.1.4.2:** AirPol, Inc., "Gas Suspension Absorption Project Technical Description".

6. Tennessee Valley Authority. Characterization of 10-MW Spray Dryer/Electrostatic Precipitator By-Product (Medium-Sulfur Coal Testing) Final Report. 1989.

7. Ibid.

8. Tennessee Valley Authority. Environmental Assessment, Atmospheric Fluidized Bed Combustion 160-MW Add-On Boiler, Shawnee Steam Plant. 1984.

9. U.S. Department of Agriculture, Soil Conservation Service. Soil Survey of Ballard and McCracken Counties, Kentucky. 1976.

10. Tennessee Valley Authority. Shawnee Groundwater Assessment Phase I. 1989.

11. Tennessee Valley Authority. "Appendix VII - TVA Power Plant Groundwater Assessment Plan Phase I." 1987.

12. Commonwealth of Kentucky. Water Quality Regulations, 401 KAR 5:026, "Classification of Waters".

13. Rodger Thomas, specialist, TVA Water Quality and Environmental Regulations. Telephone conversation with KDWQ office. May 1990.

14. **Source for Section 3.3.2:** Tennessee Valley Authority. Shawnee Groundwater Assessment Phase I. 1989.

15. **Source for Section 3.4 and its Subsections (with the exception of Subsection 3.4.3.1)**: Tennessee Valley Authority. Environmental Assessment, Atmospheric Fluidized Bed Combustion 160-MW Add-on Boiler, Shawnee Steam Plant. 1984.

16. *Correspondence from Karen M. Khonsari, Office of Clean Coal* Technology, Department of Energy, to Bruce Gold, Environmental Scientist, Tennessee Valley Authority. October 3, 1990.

17. Ibid.

18. Brian M. Butler, et. al. "Archaeological Survey and Evaluation for the Shawnee 200-MW AFBC Plant McCracken County, Kentucky." 1981.

19. Mike McRee. "TVA Flood Protection and Water Resources, 100-year and 500-year Flood Elevation Table for Ohio River Mile 945-947." Correspondence to Joe Johnson, TVA. March 16, 1990.

APPENDIX A

TVA's Environmental Decision Record

Project Identification
(Assigned by originating organization)

ENVIRONMENTAL DECISION RECORD

nization proposing action Research & Development
ject Manager* H.B. Flora Address MR 3N 45A Phone 5642
Preparer T.A. Burnett Address MR 3N 89A Phone 5938
on title TVA/DOE/AirPol Inc. Gas Suspension Absorption Process Testing

cribe the action including its purpose, cost, and schedule The proposed installation of the Gas spension Absorption (GSA) process at TVA's Shawnee Test Facility would allow continued development on this gas desulfurization (FGD) system for potential use on the TVA Power Systems. The cost of this proposed ation pilot plant testing is currently estimated at $2.0M for design and construction and $3.4M for operation nd testing. The preliminary design is underway with construction targeted for Spring/Summer 1991. The nt will operate for approximately one year (October 1991 to September 1992). This is a DOE Clean Coal Technology ject - Round III.

	Potential Effects**							Requirements**					
	NONE	INDIRECT	ADVERSE	CONSTRUCTION	BENEFICIAL	UNKNOWN	NONE	NONE	NEPA	CONSULTATION	PERMIT	PUBLIC	INFORAMTION SOURCE OR DOCUMENTATION (NOTE NAME OF TECHNICAL MEDIA PERSON PROVIDING INPUT OR REFERENCE DOCUMENT) ADDITIONAL MATERIAL MAY BE ATTACHED. THIS COLUMN SHOULD BE COMPLETED FOR EACH APPLICABLE CATEGORY.
ECT CATEGORIES													
TE STREAM GENERATION OR ALTERATION													
Air		✓								✓			T.A. Burnett Notify KY
astewater		✓								✓			T.A. Burnett Notify KY
olid waste		✓							✓				T.A. Burnett
azardous waste		✓							✓				T.A. Burnett
ITE AND LAND DEVELOPMENT													
hanges in site land-use		✓							✓				T.A. Burnett
ompatible with adjacent land uses	✓								✓				T.A. Burnett
rosion/sedimention		✓							✓				T.A. Burnett
ransportation						✓			✓				
Stream Modification						✓			✓				
istoric, cultural, and rcheological resources						✓			✓				
OISE													
Impacts on community						✓			✓				T.A. Burnett
TURAL FEATURES													
roundwater	✓								✓				T.A. Burnett
Surface water	✓								✓				T.A. Burnett
loodplains	✓								✓				T.A. Burnett
etlands	✓								✓				T.A. Burnett
Prime farmland	✓								✓				T.A. Burnett
Unique natural features	✓								✓				T.A. Burnett
egetation and wildlife	✓								✓				T.A. Burnett
hreatened or endangered species	✓								✓				T.A. Burnett
isual		✓							✓				T.A. Burnett

Individual responsible for compliance with environmental requirements and commitments.

* One or more of these categories may be checked; certian categories may not apply.

EL OF NEPA REVIEW DETERMINATION (check one)

X Categorical Exclusion pursuant to section 5.2 -21 . TVA Instruction IX ENVIRONMENTAL REVIEW (conditions and/or commitments listed below).

Environmental Assessment Required

Environmental Impact Statement Required

ject conditions or commitments related to environmental protection. (Additional erial may be attached.)

Gordon G Park 5/18/90

Hollis B. Flora, II
Signature, Project Manager

4/19/90
Date

tachments: Yes ____ No X
If yes, No. of pages ____

: (with any attachments):
Manager, Enviornmental Compliance Department SPB 2S 226P-K
Operating Group, Environmental Coordinator

NVIRONMENTAL QUALITY STAFF (EQS) CONCURRENCE:

☒ Concur with the above findings and determination of the level of NEPA review required for this action. The concurrence is conditioned on the following actions or commitments (if any) being conducted as listed below.

☐ Do not cocur with the above findings and determination of the level of NEPA review required for this action. My reasons are provided below.

EQS concurrence conditioned on notification of State of Kentucky of all activities

Richard M. Shuman — 6654-K — 5-22-90
Signature, EQS official* Phone number Date

* Original EDR returned to Project Manager with copy to operating group environmental coordinator.

(Revision 6/13/89)

APPENDIX B

Shawnee Steam Plant
Air Emissions and Waste Water
Discharge Permits

AUG 15 19[illegible]

Kentucky Natural Resources and Environmental Protection Cabinet
Department for Environmental Protection
Division for Air Quality

PERMIT

TENNESSEE VALLEY AUTHORITY
201 Summer Place Building
Knoxville, Tennessee 37902

RE: Shawnee Plant, Paducah, Kentucky

Pursuant to your application which was determined to be complete by this office on March 31, 1987, the Natural Resources and Environmental Protection Cabinet issues this permit for the operation of the equipment specified herein in accordance with the plans, specifications, and other information submitted with your application. This permit has been issued under the provisions of KRS Chapter 224.033 and regulations promulgated pursuant thereto and is subject to all conditions and operating limitations contained herein. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits, licenses, or approvals required by this Cabinet and/or other state, federal, and local agencies.

POINT OF EMISSION	AFFECTED FACILITY	CONDITIONS
01-10(1-5)	Ten Coal Fired Indirect Heat Exchangers (Units 1-10)	1. 1,617 mmBTU/hr maximum heat input, each. 2. Particulate emissions shall not exceed 0.11 lb/mmBTU, each. 3. Visible emissions shall not exceed 20% opacity.
11 (-)	Coal Handling	12,264,000 tons/yr maximum
12 (-)	Limestone Handling	17,500 tons/yr maximum
13 (-)	Fly Ash Handling System (Slurry Tower)	1. 125 tons/hr and 1,095,000 tons/yr, total maximum operating rates. 2. Particulate emissions shall not exceed 5.69 lbs/hr and 24.9 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.

No deviation from the plans and specifications submitted with your application or the conditions specified herein is permitted, unless authorized in writing by the Division for Air Quality. This permit shall become null and void at any time the terms and conditions contained herein are violated. All rights of inspection by the representatives of the Division for Air Quality are reserved. Responsibility for satisfactory conformance with all Air Quality Regulations must be borne by the permittee.

PERMIT NUMBER: O-87-052
FILE NUMBER: 072-2460-0006
REGION: Paducah/Cairo
COUNTY: McCracken
SIC CODE: 4911

Issued this 20th day of June 1987

Roger B. McCann, Director
Division for Air Quality

Point of Emission	Affected Facility	Conditions
14 (14)	Lime Silo	1. 0.989 tons/hr and 8,664 tons/yr maximum processing rates. 2. Particulate emissions shall not exceed 2.40 lbs/hr and 10.5 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
15 (15)	Waste Silo	1. 1.63 tons/hr and 14,279 tons/yr maximum processing rates. 2. Particulate emissions shall not exceed 3.29 lbs/hr and 14.4 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
40 (-)	Five Degreasers	

GENERAL CONDITIONS:

1. The permittee shall maintain and make available for inspection by personnel from the Kentucky Division for Air Quality all production records necessary to assure that the allowable emission and production rates will not be exceeded.

2. In no way does this permit relieve the permittee from compliance with all applicable emission and air quality standards.

3. All control devices shall be properly maintained, kept in good operating condition, and used in conjunction with their associated processes at all times.

4. Malfunction and shut down of air pollution control equipment shall be promptly reported to the Division in accordance with Regulation 401 KAR 50:055, Section 1.

5. In no way does this permit relieve the permittee from the responsibility of controlling emissions at all times in accordance with Kentucky Division for Air Quality Regulation 401 KAR 63:010, Fugitive emissions.

6. Opacity and sulfur dioxide emissions from the coal-fired indirect heat exchangers shall be monitored and reported in accordance with Regulation 401 KAR 61:005, Section 3 and/or 61:015, Section 6.

7. Sulfur dioxide emissions from Units 1-8 and Unit 9 or 10, whichever is not supplying flue gases to any experimental scrubber, shall not exceed 1.2 lbs/mmBTU.

PERMIT NUMBER: O-87-052

PERMIT - Continued

AUG 15 1988

8. Sulfur dioxide emissions from Unit 9 or 10 shall not exceed 8.0 lbs/mmBTU during those periods when the affected facility is being operated for the purpose of generating high sulfur dioxide content flue gases for use in any experimental sulfur dioxide removal system.

9. The following conditions apply to either unit 9 or 10, whichever one is supplying flue gas to the experimental sulfur dioxide scrubber facilities:
   a. Whenever the sulfur dioxide scrubbing facilities will be inoperative due to a scheduled shutdown which will exceed 10 days, the permittee shall revert to low-sulfur coal and achieve compliance with 1.2 lb/10^6 BTU emission limit within 5 generating unit operating days after termination of scrubbing activities.
   b. Whenever the sulfur dioxide scrubber facilities will be inoperative due to a non-scheduled shutdown projected to exceed 10 days, the permittee shall revert to low-sulfur coal and achieve compliance with the 1.2 lb/10^6 BTU within 5 generating unit operating days after such determination but not more than 10 generating unit operating days after such termination of scrubbing activities.
   c. When the sulfur dioxide scrubbing facilities are scheduled to begin operation following a period of the generating unit burning low-sulfur coal, high-sulfur coal may be added to the bunker 3 generating unit operating days before the scrubbing facilities are to begin operation.

10. All particulate emission limitations specified herein shall be as measured by Reference Method 5, 40 CFR 60, Appendix A, or such other methods as approved by the Division and EPA.

11. All sulfur dioxide emission limitations specified herein shall be as measured by Reference Method 6, 40 CFR 60, Appendix A.

12. Sulfur dioxide scrubbing facilities and scrubbing facilities as specified herein shall mean wet and/or dry scrubbing facilities.

13. On or before November 11, 1987, the permittee shall provide the Division with a source operating permit application in accordance with Section 5 of Regulation 401 KAR 63:021 or a written demonstration that the aforementioned regulation does not apply.

Kentucky Department for Environmental Protection
Division for Air Quality

AUG 15 198

PERMIT

TENNESSEE VALLEY AUTHORITY
201 Summer Place Building
Knoxville, Tennessee 37902

RE: Shawnee Power Plant

Pursuant to your application which was determined to be complete by this office on October 26, 1987, the Natural Resources and Environmental Protection Cabinet issues this permit for the construction of the equipment specified herein in accordance with the plans, specifications, and other information submitted with your application. This permit has been issued under the provisions of KRS Chapter 224.033 and regulations promulgated pursuant thereto and is subject to all conditions and operating limitations contained herein. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits, licenses, or approvals required by this Cabinet and/or other state, federal, and local agencies.

POINT OF EMISSION	AFFECTED FACILITY	CONDITIONS
16 (16)	AFBC demonstration electric utility steam generating unit	1. 1,579 mmBTU/hr maximum heat input. 2. Particulate emissions shall not exceed 0.03 lb/mmBTU and 207 tons/yr. 3. Sulfur dioxide emissions shall not exceed 1.2 lbs/mmBTU and 6,743 tons/yr. 4. Nitrogen oxide emissions shall not exceed 0.6 lb/mmBTU and 4,150 tons/yr. 5. Carbon monoxide emissions shall not exceed 0.4 lb/mmBTU and 2,766 tons/yr. 6. Visible emissions shall not exceed 20% opacity. 7. Maximum coal burned shall not exceed 678,000 tons/yr.

No deviation from the plans and specifications submitted with your application or the conditions specified herein is permitted, unless authorized in writing by the Division for Air Quality. This permit shall become null and void at any time the terms and conditions contained herein are violated. All rights of inspection by the representatives of the Division for Air Quality are reserved. Responsibility for satisfactory conformance with all Air Quality Regulations must be borne by the permittee.

PERMIT NUMBER: C-88-040
FILE NUMBER: 072-2460-0006
REGION: Paducah/Cairo
COUNTY: McCracken
SIC CODE: 4911

Issued this 4th day of May 19 88

William C. Eddins, Director

James T. Corum, D. M. D., M. P. H., Commissioner

PERMIT NUMBER: C-88-040

PERMIT - Continued

AUG 15 1989

Point of Emission	Affected Facility	Conditions
17 (-)	Coal crusher/dryer system	1. 90 tons/hr and 678,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.031 gr/dscf. 3. Visible emissions shall not equal or exceed 20% opacity.
18 (18)	Coal transfer point and station	1. 700 tons/hr and 678,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.457 lb/hr and 2.0 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
19 (19)	AFBC coal bunker exhaust	1. 700 tons/hr and 678,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.519 lb/hr and 2.27 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
20 (20)	Central vacuum cleaning system building exhaust	1. 700 tons/hr and 678,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.123 lb/hr and 0.539 ton/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
21 (21)	Limestone unloader	1. 1,500 tons/hr and 300,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.144 lb/hr and 0.63 ton/yr. 3. Visible emissions shall not exceed 10% opacity.
22 (22)	Limestone stockout conveyor	1. 1;500 tons/hr and 300,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.45 lb/hr and 1.97 tons/yr. 3. Visible emissions shall not exceed 10% opacity.

PERMIT NUMBER: C-88-040

PERMIT - Continued

Feb 15 1989

Point of Emission	Affected Facility	Conditions
23 (23)	Limestone stockpile	1. 1,500 tons/hr and 300,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.84 lb/hr and 3.68 tons/yr. 3. Visible emissions shall not exceed 10% opacity.
24 (24)	Limestone reclaim conveyor	1. 400 tons/hr and 300,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.056 lb/hr and 0.25 ton/yr. 3. Visible emissions shall not exceed 10% opacity.
25 (25)	Limestone conditioner building	1. 400 tons/hr and 300,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 1.84 lbs/hr and 8.06 tons/yr. 3. Visible emissions shall not exceed 7% opacity.
26 (26)	Limestone recycle conveyor	1. 200 tons/hr and 225,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.214 lb/hr and 0.937 ton/yr. 3. Visible emissions shall not exceed 7% opacity.
27 (27)	Limestone product conveyor and bunker exhaust	1. 200 tons/hr and 300,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 1.27 lbs/hr and 5.56 tons/yr. 3. Visible emissions shall not exceed 7% opacity.
29 (29)	Five mechanical collectors surge bins	1. 18 tons/hr and 88,500 tons/yr maximum operating rates, each. 2. Particulate emissions shall not exceed 0.926 lb/hr and 4.06 tons/yr, total. 3. Visible emissions shall not equal or exceed 20% opacity.
30 (30)	Two fly ash transfer silos	1. 100 tons/hr and 673,000 tons/yr total maximum operating rates. 2. Particulate emissions shall not exceed 1.89 lbs/hr and 8.29 tons/yr, total. 3. Visible emissions shall not equal or exceed 20% opacity.

PERMIT NUMBER: C-88-040

PERMIT - Continued

AUG 15 1989

Point of Emission	Affected Facility	Conditions
31 (31)	Two fly ash disposal silos	1. 100 tons/hr and 673,000 tons/yr total maximum operating rates. 2. Particulate emissions shall not exceed 0.701 lb/hr and 3.07 tons/yr, total. 3. Visible emissions shall not equal or exceed 20% opacity.
32 (32)	Two fly ash disposal silos unloading (conditioned)	1. 460 tons/hr, each, and 774,000 tons/yr, total, maximum operating rates. 2. Particulate emissions shall not exceed 1.89 lbs/hr and 6.14 tons/yr, total. 3. Visible emissions shall not equal or exceed 20% opacity.
33 (32a)	Fly ash disposal silo unloading (dry)	1. 300 tons/hr and 673,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.021 lb/hr and 0.092 ton/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
34 (34)	AFBC spent bed material disposal silo	1. 30 tons/hr and 122,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.54 lb/hr and 2.37 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
35 (35)	AFBC fly ash char disposal silo	1. 45 tons/hr and 260,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.617 lb/hr and 2.70 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
36 (36)	AFBC fly ash char and spent bed material silos unloading (conditioned)	1. 690 tons/hr and 382,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 2.16 lbs/hr and 9.46 tons/yr. 3. Visible emissions shall not equal or exceed 20% opacity.

PERMIT NUMBER: C-88-040

AUG 15 1989

PERMIT - Continued

Point of Emission	Affected Facility	Conditions
37 (36a)	AFBC spent bed material unloading (dry)	1.200 tons/hr and 106,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 0.0008 lb/hr and 0.0035 ton/yr. 3. Visible emissions shall not equal or exceed 20% opacity.
38 (33,37)	Fly ash, fly ash-char, and spent bed material hauling	1. 775 tons/hr and 1,156,000 tons/yr maximum operating rates. 2. Particulate emissions shall not exceed 2.4 lbs/hr and 7.8 tons/yr.
39 (38)	Waste stockpile	1. Particulate emissions shall not exceed 0.228 lb/hr and 1.0 ton/yr. 2. Visible emissions shall not equal or exceed 20% opacity.

GENERAL CONDITIONS:

1. The owner and/or operator of the affected facilities specified on this permit shall furnish to the Division for Air Quality the following:
   a) Written notification, postmarked within 15 days, of the date construction commenced. (See Condition 2)
   b) Written notification of the actual date of start-up and the date of achieving the maximum production rate of each of the affected facilities listed on this permit. This notification must be postmarked within 15 days after each of the above mentioned events. (See Condition 3)
   c) Within 15 days after demonstration of compliance, an application for a permit to operate. (See Condition 3)

2. Unless construction is commenced on or before eighteen months from the date of this permit or if construction is commenced and then stopped for any consecutive period of six months or more, then this construction permit shall be null and void.

PERMIT NUMBER: C-88-040

PERMIT - Continued

AUG 15 1989

3. a) This construction permit shall allow time for the initial start-up, operation and performance testing of the affected facilities listed herein. However, within 60 days after achieving the maximum production rate at which the affected facilities will be operated, but not later than 180 days after initial start-up of such facilities, the owner or operator shall conduct particulate, sulfur dioxide, nitrogen oxide, and carbon monoxide performance tests on the AFBC demonstration unit, emission point 16(16), and particulate performance tests on the coal crusher/dryer system, emission point 17(-), and the remaining processes as required by 401 KAR 59:005, Section 2, and furnish the Division a written report of the results of such performance tests.

b) Unless notification and justification to the contrary are received by this Division, the date of achieving the maximum production rate at which the affected facilities will be operated shall be deemed to be 30 days after initial start-up.

c) At least 30 days prior to the date of the required performance test(s), the permittee shall complete and return a Compliance Test Protocol (Form DEP6027). The Protocol form shall be utilized by the Division to determine if a pretest meeting is required. The Division shall be notified of the actual test date at least 10 days prior to the tests.

4. Operation of an affected facility is considered to have commenced at any time air pollutants are generated and emitted to the atmosphere by that affected facility.

5. All air pollution control equipment and all air pollution control measures proposed by the application in response to which this permit is issued shall be in place and operational at any time an affected facility is operated.

6. Those affected facilities specified herein whose continued compliance has been demonstrated to the Division's satisfaction are hereby authorized by this permit to operate for 90 calendar days following such compliance demonstration or for such additional period as may be authorized by 401 KAR 50:035, Section 1(2)(c). Authorization for operation provided by 401 KAR 50:035, Section 1(2)(c), shall expire thirty (30) days after the date notification is made to the source by the Department that an operating permit fee balance is due or immediately upon notification to the source by the Department that the source operating permit is denied.

7. Those affected facilities specified herein for which compliance has not been demonstrated during the time period specified by General Condition 3 shall not be operated unless authorized in writing by the Director.

8. The permittee shall maintain and make available for inspection by this Division all production records necessary to assure that the allowable annual production rates will not be exceeded.

9. In no way does this permit relieve the permittee from compliance with all applicable emission and air quality standards.

10. An operating permit cannot be issued for the affected facilities listed on this permit unless the remainder of the source's affected facilities are either in compliance, shut down, or on an approved compliance schedule.

11. The particulate emission limitation specified herein for the AFBC electric utility steam generating unit shall be as measured by 40 CFR 60 Appendix A, Reference Method 5 or such other methods as approved by the Division and EPA.

PERMIT NUMBER: C-88-040

AUG 15 1989

PERMIT - Continued

12. The sulfur dioxide, nitrogen oxide, and carbon monoxide emission limitations specified herein for the AFBC electric utility steam generating unit shall be as measured by 40 CFR 60, Appenidx A, Reference Methods 6, 7, and 10, respectively.

13. Particulate emission limitations specified herein for the process operations shall be as measured by Kentucky Reference Method 50.

14. Visible emissions limitations specified herein shall be as measured by 40 CFR 60, Appendix A, Reference Methods 9 or 22, or Kentucky Method 150(F-1), as required by the provisions of the applicable regulation.

15. Fugitive emissions from the haul roads shall be controlled in accordance with Regulation 401 KAR 63:010.

16. Particulate, sulfur dioxide, and nitrogen oxide emissions from the AFBC indirect heat exchanger shall be monitored and reported in accordance with Regulation 401 KAR 59:016, Sections 7 and 8.

17. The AFBC demonstration unit and Unit 10 shall not be operated simultaneously.

18. Construction permit, C-86-248, issued December 23, 1986, is hereby null and void

19. Sulfur dioxide emissions shall be reduced by 70% when emissions are less than 0.6 lb/mmBTU and 90% when emissions are equal to or greater than 0.6 lb/mmBTU.

20. The opacity of intermittent fugitive emissions from any affected facility subject to Regulation 401 KAR 59:010 shall be less than 20% as measured by Kentucky Method 150(F-1) and shall not remain visible beyond the property line of the permittee.

21. The opacity of continuous fugitive emissions from any affected facility subject to Regulation 401 KAR 59:010 shall be less than 20% as measured by Reference Method 9, 40 CFR 60, Appendix A, and shall not remain visible beyond the property line of the permittee.

AUG 15 1989

Kentucky Natural Resources and Environmental Protection Cabinet
Department for Environmental Protection
Division for Air Quality

PERMIT

TENNESSEE VALLEY AUTHORITY
201 Summer Place Building
Knoxville, Tennessee 37902

RE: Shawnee Power Plant

Pursuant to your application which was determined to be complete by this office on December 1, 1987, the Natural Resources and Environmental Protection Cabinet issues this permit for the construction of the equipment specified herein in accordance with the plans, specifications, and other information submitted with your application. This permit has been issued under the provisions of KRS Chapter 224.033 and regulations promulgated pursuant thereto and is subject to all conditions and operating limitations contained herein. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits, licenses, or approvals required by this Cabinet and/or other state, federal, and local agencies.

POINT OF EMISSION	AFFECTED FACILITY	CONDITIONS
40 (41-46)	Coal Stacker/Reclaimer	Maximum operating rates shall not exceed 1,400 tons/hr and 12,200,000 tons/yr.

No deviation from the plans and specifications submitted with your application or the conditions specified herein is permitted, unless authorized in writing by the Division for Air Quality. This permit shall become null and void at any time the terms and conditions contained herein are violated. All rights of inspection by the representatives of the Division for Air Quality are reserved. Responsibility for satisfactory conformance with all Air Quality Regulations must be borne by the permittee.

PERMIT NUMBER: C-88-017
FILE NUMBER: 072-2460-0006
REGION: Paducah/Cairo
COUNTY: McCracken
SIC CODE: 4911

Issued this 21st day of March 19 88

Roger B. McCann, Director
Division for Air Quality

DEP7001 (2-87)

PERMIT NUMBER: C-88-017

PERMIT - Continued

AUG 15 1989

GENERAL CONDITIONS:

1. The owner and/or operator of the affected facilities specified on this permit shall furnish to the Division for Air Quality the following:
   a) Written notification, postmarked within 15 days, of the date construction commenced. (See Condition 2)
   b) Written notification of the actual date of start-up and the date of achieving the maximum production rate of each of the affected facilities listed on this permit. This notification must be postmarked within 15 days after each of the above mentioned events. (See Condition 3)
   c) Within 15 days after demonstration of compliance, an application for a permit to operate. (See Condition 3)

2. Unless construction is commenced on or before eighteen months from the date of this permit or if construction is commenced and then stopped for any consecutive period of six months or more, then this construction permit shall be null and void.

3. a) This construction permit shall allow time for the initial start-up, operation and compliance demonstration of the affected facilities listed herein. However, within 60 days after achieving the maximum production rate at which the affected facilities will be operated, but not later than 180 days after initial start-up of such facilities, the owner or operator shall demonstrate compliance to a duly authorized representative of the Division.
   b) Unless notification and justification to the contrary are received by this Division, the date of achieving the maximum production rate at which the affected facilities will be operated shall be deemed to be 30 days after initial start-up.

4. Operation of an affected facility is considered to have commenced at any time air pollutants are generated and emitted to the atmosphere by that affected facility.

5. All air pollution control equipment and all air pollution control measures proposed by the application in response to which this permit is issued shall be in place and operational at any time an affected facility is operated.

6. Those affected facilities specified herein whose continued compliance has been demonstrated to the Division's satisfaction are hereby authorized by this permit to operate for 90 calendar days following such compliance demonstration or for such additional period as may be authorized by 401 KAR 50:035, Section 1(2)(c). Authorization for operation provided by 401 KAR 50:035, Section 1(2)(c), shall expire thirty (30) days after the date notification is made to the source by the Department that an operating permit fee balance is due or immediately upon notification to the source by the Department that the source operating permit is denied.

PERMIT NUMBER: C-90-016

PERMIT - Continued

POINT OF EMISSION	AFFECTED FACILITY	CONDITIONS
28 (28)	Emergency reclaim dump	1. Maximum operating rate shall not exceed 200 tons/hour. 2. Particulate emissions shall not exceed 0.065 lb/hour. 3. Visible emissions shall not exceed 10% opacity.

GENERAL CONDITIONS:

1. The owner and/or operator of the affected facilities specified on this permit shall furnish to the Division for Air Quality the following:
   a) Written notification, postmarked within 15 days, of the date construction commenced. (See Condition 2)
   b) Written notification of the actual date of start-up and the date of achieving the maximum production rate of each of the affected facilities listed on this permit. This notification must be postmarked within 15 days after each of the above mentioned events or within 15 days after the issuance of this permit, whichever is later. (See Condition 3)
   c) Within 15 days after demonstration of compliance, an application for a permit to operate. (See Condition 3)

2. Unless construction is commenced on or before eighteen months from the date of this permit or if construction is commenced and then stopped for any consecutive period of six months or more, then this construction permit shall be null and void.

3. a) This construction permit shall allow time for the initial start-up, operation and compliance demonstration of the affected facilities listed herein. However, within 60 days after achieving the maximum production rate at which the affected facilities will be operated, but not later than 180 days after initial start-up of such facilities, the owner or operator shall demonstrate compliance to a duly authorized representative of the Division.
   b) Unless notification and justification to the contrary are received by this Division, the date of achieving the maximum production rate at which the affected facilities will be operated shall be deemed to be 30 days after initial start-up.

4. Operation of an affected facility is considered to have commenced at any time air pollutants are generated and emitted to the atmosphere by that affected facility.

5. Operation of any affected facility without the operation of control equipment required for compliance with applicable regulations is prohibited.

PERMIT - Continued

GENERAL CONDITIONS:

6. Those affected facilities specified herein whose continued compliance has been demonstrated to the Division's satisfaction are hereby authorized by this permit to operate for 90 calendar days following such compliance demonstration or for such additional period as may be authorized by 401 KAR 50:035, Section 1(2)(c). Authorization for operation provided by 401 KAR 50:035, Section 1(2)(c), shall expire thirty (30) days after the date notification is made to the source by the Department that an operating permit fee balance is due or immediately upon notification to the source by the Department that the source operating permit is denied.

7. Those affected facilities specified herein for which compliance has not been demonstrated during the time period specified by General Condition 3 shall not be operated unless authorized in writing by the Director.

8. The permittee shall maintain and make available for inspection by this Division all production records necessary to assure that the allowable production rates will not be exceeded.

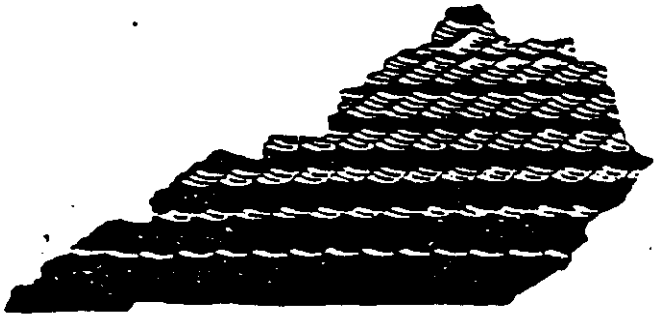
9. In no way does this permit relieve the permittee from compliance with all applicable emission and air quality standards.

10. An operating permit cannot be issued for the affected facilities listed on this permit unless the remainder of the source's affected facilities are either in compliance, shut down, or on an approved compliance schedule.

11. Particulate and visible emission limitations specified herein shall be as measured by Reference Methods 5 and 9, respectively, as referenced in Regulation 401 KAR 50:015, Section 1.

12. Simultaneous operation of the Coal Stacker/Reclaimer and emergency stockout conveyor is prohibited.

KPDES



Kentucky Pollutant Discharge Elimination System

PERMIT

PERMIT NO. KY0004219

AUTHORIZATION TO DISCHARGE UNDER THE KENTUCKY POLLUTANT DISCHARGE ELIMINATION SYSTEM

Pursuant to Authority in KRS 224,

The Tennessee Valley Authority
Knoxville, Tennessee 37902

is authorized to discharge from a facility located at

Shawnee Steam Plant
Kentucky Highway 996
West Paducah, McCracken County, Kentucky 42086

to receiving waters named

Ohio River - Discharges 001, 002, 003, 004, 010 .
Little Bayou Creek - 009

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof. The permit consists of this cover sheet, Part I 8 page(s), Part II 1 page(s), Part III 2 page(s), and Part IV 3 page(s).

This permit shall become effective on OCT 4 - 1986

This permit and the authorization to discharge shall expire at midnight, OCT 3 - 1991

9/29/86
Date Signed

Donald F. Harker, Jr., Director
Division of Water

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 001 - Internal wastestream - ash pond discharge to the condenser cooling water channel.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
	kg/day(lbs/day)		Other Units(Specify)			
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow-m^3/day (MGD)	—	—	—	—	1/Week 1/	Weir elevation
Oil and Grease	—	—	13 mg/l	13 mg/l	2/Month 1/	Grab
Total Suspended Solids	—	—	30 mg/l	62 mg/l	2/Month 1/	Grab
Heavy Metals Monitoring 2/	—	—	—	—	1/Quarter	Grab

The effluent pH sh ll not be less than 6.0 standard units at any time, and shall be monitored 1/week by grab sample. 3/ Prior to converting to dry fly ash disposal, permittee shall conduct necessary assessments and install any treatment facilities required to assure that pH limitations are achieved.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Discharge from ash pond prior to mixing with any other wastestream.

1/ One additional grab sample shall be collected and analyzed for Oil and Grease and Total Suspended Solids approximately during a period of maximum expected flow for each rainfall event exceeding one inch per day. The corresponding flow shall be reported. The permittee shall report the presence of cenospheres observed in the samples. After a period of one year following the effective date of this permit, the permittee may request elimination or reduction of frequency of this sampling.

2/ Heavy Metals Monitoring shall include total recoverable Iron, Arsenic, Selenium and Aluminum.

3/ In the event that TVA - Shawnee discharges metal cleaning waste to the ash pond, the ash pond effluent pH shall not be less than 9.(standard units during the period of discharge and 30 days thereafter, and shall be monitored once per day for a period of two week: beginning at the start of discharge of metal cleaning operations to the ash pond. The ash pond pH shall be monitored once per week for al other periods of time. Notwithstanding the above, the permittee may submit information which indicates that the equivalent treatment for metal cleaning wastes can be achieved at an ash pond pH of less than 9.0, and with the approval of the director and subject to public notice if required, may conduct an insitu demonstration of equivalent treatment. If determined successful, the permittee may request a modification of permit limitations and monitoring requirements based thereon. After a period of six months following the effective date of this permit, the permittee may request reduction of frequency of this sampling.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS:

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 002 - once through cooling water.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS					MONITORING REQUIREMENTS	
	kg/day (lbs/day)		Other Units (Specify)				
	Monthly Avg.	Daily Max.	Avg.	Daily Max.	Instantaneous Max.	Measurement Frequency	Sample Type
Flow-m^3/day (MGD)	—	—	—	—	N/A	Continuous	Recorder or pump logs
Intake Temperature $^oC(^oF)$	—	—	—	—	N/A	Continuous	Recorder
Discharge Temperature $^oC(^oF)$	—	—	—	36.7(98.0) 1/ 2/	N/A	1/day	Calculation 2/
Free Available Chlorine (mg/l) 3/	—	—	0.2 mg/l 6/	-	0.5 mg/l -	1/week 4/	Multiple grabs 4/
Chlorine Addition Period (min/day/unit) 3/	—	—	—	120 5/	N/A	1/day	Logs
Heat Discharge BTU/hr	-	-	-	2/ 7/	N/A	1/day	Calculation 2/

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations(s): Outlet corresponding to an individual unit prior to mixing with other waste streams except that pH shall be monitored at discharge canal weir, and intake temperature shall be monitored at the plant intake.

1/ In no case may the cooling water discharge raise the stream temperature above the following values outside a reasonable mixing zone as defined by the TVA - Shawnee thermal plume study:

Month/Date	Period Average (°F)	Instantaneous Maximum (°F)
January 1-31	45	50
February 1-29	45	50
March 1-15	51	56
March 16-31	54	59
April 1-15	58	64
April 16-30	64	69
May 1-15	68	73
May 16-31	75	80
June 1-15	80	85
June 16-30	83	87
July 1-31	84	89
August 1-31	84	89
September 1-15	84	87
September 16-30	82	86
October 1-15	77	82
October 16-31	72	77
November 1-30	67	72
December 1-31	52	57

2/ 24-hour average intake temperature, 24-hour average flow, and 24-hour average plant load shall be used in these calculations.
3/ Limitations and monitoring requirements are not applicable for any day in which chlorine is not added.
4/ Multiple grabs shall consist of at least 3 representative grab samples collected at approximately equally spaced intervals during the last 30 minutes of FAC discharge. Weekly sampling shall include 3 or 4 units so that all 10 units are sampled once per three weeks if operating.
5/ Total residual chlorine may not be discharged from any single generating unit for more than two hours per day unless the discharger demonstrates to the permitting authority that discharge for more than two hours is required for macroinvertebrate control. Simultaneous multi-unit chlorination is prohibited.
6/ Average FAC limitation is applicable during any individual chlorine discharge period.
7/ In the event that surface elevation of the Ohio River in the vicinity of the plant is below 305 feet MSL, the applicable limitation shall be 8 X 10^9 BTU/hr.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit the permittee is authorized to discharge from outfall(s) serial number(s) 003 - Internal wastestream - sanitary wastes treatment plant effluent discharged to the condenser cooling water channel.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
	kg/day(lbs/day)		Other Units(Specify)			
	Monthly Avg.	Daily Max.	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow m^3/day (MGD)	—	--	--	—	1/Month	Instantaneous
BOD (5-day)	—	--	30 mg/l	45 mg/l	1/Month	Grab
Total Suspended Solids	--	--	30 mg/l	45 mg/l	1/Month	Grab
Fecal Coliform (# Colonies/100 ml)	—	--	200/	400/	1/Month	Grab
Total Residual Chlorine	--	--	--	—	1/Month	Grab

The pH of the effluent shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/month by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): sanitary wastes treatment plant effluent prior to mixing with any other waste stream.

This sewage plant and its associated discharge shall be observed at least daily to determine if it is operating efficiently, and a log shall be kept as a record of these daily observations. In addition, major operational items shall be checked daily, and a log maintained of these checks. The logs shall include the date of observation, inspection person, comments on the plants operation, and steps taken to correct any operational problems. The log shall be made available during on-site inspections by the Natural Resources and Environmental Protection Cabinet and/or the Environmental Protection Agency.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 004 5/ - Internal wastestream - metal cleaning wastes discharged to the ash pond after pretreatment (if necessary).

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTICS	DISCHARGE LIMITATIONS				MONITORING REQUIREMENTS	
	kg/day (lbs/day)		Other Units (mg/l)			
	Monthly Avg.	Daily Max.	Monthly Avg.	Daily Max.	Measurement Frequency	Sample Type
Flow-m^3/day (MGD)	--	--	--	--	1/Batch	Pump log or elevation change
Copper, Total	--	--	1.0 mg/l 1/	1.0 mg/l 1/	2/	Grab
Iron, Total	--	--	1.0 mg/l 4/	1.0 mg/l 4/	2/	Grab
Copper, Dissolved 6/	--	--	3/	3/	2/	Grab

The pH of the effluent shall not be less than N/A standard units nor greater than N/A standard units and shall be monitored N/A by grab sample.

Unless pretreated for both copper and iron (to 1.0 mg/l total) no chemicals other than hydrochloric acid, Rodine 214, ammonium biflouride, aqueous ammonia, ammonium bicarbonate, potassium bromate, trisodium phosphate, and hydrazine shall be used in a chemical metal cleaning operation.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): prior to discharge to the ash pond or mixing with any other waste stream.

The term "metal cleaning waste" shall mean any cleaning compounds, rinse waters, or any other waterborne residues derived from cleaning any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

In the event that TVA - Shawnee discharges metal cleaning waste to the ash pond, the ash pond effluent pH shall not be less than 9.0 standard units during the period of discharge and 30 days thereafter, and shall be monitored once per day for a period of two weeks beginning at the start of discharge of metal cleaning operations to the ash pond. The ash pond pH shall be monitored once per week for all other periods of time. Notwithstanding the above, the permittee may submit information which indicates that equivalent treatment for metal cleaning wastes can be achieved at an ash pond pH of less than 9.0, and with the approval of the director and subject to public notice if required, may conduct an insitu demonstration of equivalent treatment. If determined successful, the permittee may request a modification of permit limitations and monitoring requirements based there on. After a period of six months following the effective date of the permit, the permittee may request reduction of frequency of this sampling.

1/ Boiler tube cleaning shall be directed to the ash pond after preteatment for copper, if required.
2/ On start of discharge and once/week thereafter until termination of discharge with one grab sample taken immediately prior to termination of discharge.
3/ Boiler fireside, air preheater and similar cleaning wastes may be directed to the ash pond without pretreatment provided that dissolved copper concentrations do not exceed 1.0 mg/l.
4/ Limitations for iron shall be deemed met by discharge to the ash pond, provided that ash pond effluent pH is greater than or equal to 9.0 standard units during the period of discharge and for at least 30 days thereafter..
5/ Serial number assigned for identification and monitoring purposes.
6/ Analysis for dissolved copper is only required if metal cleaning wastes are directed to the ash pond without pretreatment.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS:

During the period beginning on the effective date of this permit and lasting through the term of this permit, the permittee is authorized to discharge from outfall(s) serial number(s):

009 1/ - Storm water runoff from the rail loop discharged to Little Bayou Creek
010 1/ - Storm water runoff from the parking lots and the east end of the switchyard discharged to sloughs adjacent to the Ohio River

UNCONTAMINATED STORM WATER RUNOFF FROM THESE OUTFALLS MAY BE DISCHARGED WITHOUT LIMITATION OR MONITORING REQUIREMENTS.

1/ Serial numbers assigned for identification purposes.

STANDARD CONDITIONS FOR KPDES PERMIT

The permittee is also advised that all KPDES permit conditions in KPDES Regulation 401 KAR 5:065, Section 1 will apply to all discharges authorized by this permit.

This permit has been issued under the provisions of KRS Chapter 224 and regulations promulgated pursuant thereto. Issuance of this permit does not relieve the permittee from the responsibility of obtaining any other permits or licenses required by this Cabinet and other state, federal and local agencies.

PART III

OTHER REQUIREMENTS

A. Reporting of Monitoring Results

Monitoring results obtained during the previous 3 month(s) shall be summarized for each month (each quarter if monitoring frequency is quarterly) and must be reported on a Discharge Monitoring Report Form, postmarked no later than 28th day of the month following the completed reported period and shall be submitted to:

Division of Water
Paducah District Office
1390 Irvin Cobb Drive
Paducah, Kentucky 42001
Attention: Marvin Stegmann

Kentucky Natural Resources and
Environmental Protection Cabinet
Division of Water
Inventory and Data Management
18 Reilly Road, Ft. Boone Plaza
Frankfort, Kentucky 40601

B. Reopener Clause

This permit shall be modified, or alternatively revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under 401 KAR 5:050 thru 5:085, if the effluent standard or limitation so issued or approved:

1. Contains different conditons or is otherwise more stringent than any effluent limitation in the permit; or

2. Controls any pollutant not limited in the permit.

The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

C. In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

D. There shall be no discharge of detectable amounts of polychlorinated biphenyl compounds (PCB) that originate at the TVA-Shawnee Plant such as those commonly used for transformer fluid. TVA-Shawnee Plant will not be penalized for PCB's that are present in the intake water. For purposes of detection, a detection limit of 0.1 ug/l (in water) will be used.

E. The company shall notify the Director in writing no later than ninety (90) days prior to instituting use of any additional biocide or chemical used in cooling systems, other than chlorine, which may be toxic to aquatic life other than those previously reported to the Kentucky Division of Water. Such notification shall include:

1. Name and general composition of biocide or chemical,
2. 96-hour median tolerance limit data for organisms representative of the biota of the water way into which the discharge shall occur,
3. Quantities to be used,
4. Frequencies of use,
5. Proposed discharge concentrations, and
6. EPA registration number, if applicable.

F. Coal pile runoff and low volume wastes (wastewater from all sources except those for which specific limitations are otherwise required in this permit) shall be discharged to the ash pond.

G. Flow Measurement

Permittee shall demonstrate that weirs and other devices used to measure flow at all outfall serial numbers (other than approved use of pump logs) are capable of measuring flows within a maximum derivation of less than plus or minus 10 percent from the true discharge rates throughout the range of expected discharge flows. A report shall be submitted within one year following the effective date of this permit. The permittee shall develop and implement a flow measurement quality assurance program and maintain documentation with NPDES permit records for the facility. The permittee shall certify the calibration of flow measurement devices not less than annually.

H. Site Runoff

The permittee shall maintain and implement procedures to assure adequate control of rainfall runoff from the site. Reports shall be submitted one year following the effective date of this permit and 18 months following the effective date of this permit, demonstrating the adequacy of the controls. Subsequent reporting is not necessary unless determined necessary by the Director, Division of Water.

I. Priority Pollutant Data

The permittee shall sample all point source discharges of rainfall runoff (009, 010) from the plant site to waters of the Commonwealth and shall report results no later than one year following the effective date of this permit. Analyses shall include Flow, TSS, O&G, and metals required by Parts V.B. and V.C. of KPDES Application Form C. No less than three representative samples shall be collected for TSS and O&G analyses.

PART IV

BEST MANAGEMENT PRACTICES

SECTION A. GENERAL CONDITIONS

1. Applicability

These conditions apply to all permittees who use, manufacture, store, handle or discharge any pollutant listed as toxic under Section 307 (a)(1) of the Clean Water Act, oil, as defined in Section 311 (a)(1) of the Act, and any pollutant listed as hazardous under Section 311 of the Act and who have ancillary manufacturing operations which could result in significant (as defined by the Division of Water) amounts of these pollutants reaching waters of the Commonwealth. These operations include material storage areas; plant site runoff; in-plant transfer, process and material handling areas; loading and unloading operations, and sludge and waste disposal areas.

2. BMP Plan

The permittee shall develop and implement a Best Management Practices (BMP) plan consistent with *401 KAR 5:065*, Section 2 (10) pursuant to KRS 224, which prevents, or minimizes the potential for, the release of toxic substances from ancillary activities to the waters of the Commonwealth through plant site runoff; spillage or leaks, sludge or waste disposal; or drainage from raw material storage. A Best Management Practices (BMP) plan will be prepared by the permittee unless the permittee can demonstrate through the submission of a BMP outline that the elements and intent of the BMP have been fulfilled through the use of existing plans such as the Spill Prevention Control and Countermeasure (SPCC) plans and other applicable documents.

3. Implementation

An outline shall be developed and submitted for approval within 6 months of the effective date of this permit. A BMP plan, consistent with the approved outline, shall be prepared and implemented within 6 months of approal of the BMP outline.

4. General Requirements

The BMP plan shall:

a. Be documented in narrative form, and shall include any necessary plot plans, drawings or maps.

b. Establish specific objectives for the control of toxic and hazardous pollutants.

(1) Each facility component or system shall be examined for its potential for causing a release of significant (as defined by the Division of Water) amounts of toxic or hazardous pollutants to waters of the Commonwealth due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc.

(2) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g. precipitation), or other circumstances to result in significant (as defined by the Division of Water) amounts of toxic or hazardous pollutants reaching surface waters, the plan should include a prediction of the direction, rate of flow and total quantity of toxic or hazardous pollutants which could be discharged from the facility as result of each condition or circumstance.

c. Establish specific best management practices to meet the objectives identified under paragraph b of this section, addressing each component or system capable of causing a release of significant (as defined by the Division of Water) amounts of toxic or hazardous pollutants to the waters of the Commonwealth.

d. Include any special conditions established in part B of this section.

e. Be reviewed by plant engineering staff and the plant manager.

5. Specific Requirements

The plan shall be consistent with the general guidance contained in the publication entitled "NPDES Best Management Practices Guidance Document" and shall include the following base line BMP's as a minimum.

a. BMP Committee
b. Reporting of BMP Incidents
c. Risk Identification and Assessment
d. Employee Training
e. Inspections and Records
f. Preventive Maintenance
g. Good Housekeeping
h. Materials Compatibility
i. Security
j. Materials Inventory

6. SPCC Plans

The BMP plan may reflect requirements for Spill Prevention Control and Countermeasure (SPCC) plans under Section 311 of the Act and 40 CFR Part 151, and may incorporate any part of such plans into the BMP plan by reference.

7. Hazardous Waste Management

The permittee shall assure the proper management of solids and hazardous waste in accordance with the regulations promulgated under the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1978 (RCRA) (40 U.S.C. 6901 et seq). Management practices required under RCRA regulations shall be referenced in the BMP plan. Nothing in this BMP plan or permit shall be deemed to supersede the requirements of the Resource Conservation and Recovery Act of 1978.

8. Documentation

The permittee shall maintain a description of the BMP plan at the facility and shall make the plan available to the Director within 6 months after approval of BMP outline.

9. BMP Plan Modification

The permittee shall amend the BMP plan whenever there is a change in the facility or change in the operation of the facility which materially increases the potential for the ancillary activities to result in a discharge of significant (as defined by the Division of Water) amounts of hazardous or toxic pollutants.

10. Modification for Ineffectiveness

If the BMP plan proves to be ineffective in achieving the general objective of preventing the release of significant (as defined by the Division of Water) amounts of toxic or hazardous pollutants to surface waters and the specific objectives and requirements under paragraphs b and c of Section 4, the permit and/or the BMP plan shall be subject to modification to incorporate revised BMP requirements.

SECTION B. SPECIFIC CONDITIONS

The following Specific Conditions shall be implemented within 12 months of the effective date of the permit.

1. The BMP Plan shall address the materials storage located in the area south of the eastside switchyard. The potential for contamination of runoff from the drum storage area shall be specifically addressed.
2. Significant shall be defined as discharges of pollutants reaching waters of the Commonwealth that fail to meet the requirements of the Kentucky Water Quality Regulations, Title 401, Chapter 5 (specifically including 401 KAR 5:031).

CHARLOTTE E. BALDWIN
SECRETARY

MARTHA LAYNE COLLINS
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FORT BOONE PLAZA
18 REILLY ROAD
FRANKFORT, KENTUCKY 40601

FACT SHEET

APPLICATION FOR A KENTUCKY POLLUTION DISCHARGE ELIMINATION SYSTEM PERMIT TO DISCHARGE TREATED WASTEWATER INTO WATERS OF THE COMMONWEALTH

Application No.: KY0004219 Date:

Permit Reviewer: Bruce Scott

I. SYNOPSIS OF APPLICATION

a. Name and Address of Applicant

Tennessee Valley Authority
Knoxville, Tennessee 37902

Shawnee Steam Plant
Kentucky Highway 996, P. O. Box 2000
West Paducah, Kentucky 42086

b. Description of Applicant's Operation

Coal-fired steam electric power plant for the generation of electricity (SIC Code 4911).

c. Production Capacity of Facility

Generation of electric power from ten fossil fired boilers.

d. Description of Existing Pollution Abatement Facilities

001

The ash pond is approximately 180 acres in size and has 93 acres available for containing wastewater since one half of the pond is filled with ash. The average depth is 10 feet and the average retention volume is 3 days. The inputs to the pond include bottom ash and fly ash sluice water, water treatment plant wastes, metal cleaning wastes, low volume wastes, miscellaneous equipment cooling and

lubricating water, coal pile runoff, discharges from the Atmospheric Fluidized Bed Combustion (AFBC) Pilot Plant, future runoff discharges from the limestone storage area and the AFBC add-on boiler spent bed material and spray dryer disposal area, low volume waste discharges from the existing 2-MW research scrubber and future discharges from a 10-MW research scrubber.

The AFBC discharge is covered by NPDES Permit No. KY0053678 and consists of boiler blowdown, treated domestic waste, water treatment wastes, low volume wastes, runoff from the coal pile, limestone storage area, wet dust suppression and construction. Metal cleaning waste (including air preheater wash) are not allowed to be discharged to the ash pond pond pursuant to KY0053678, Part III-D. This requirement is subject to change upon reissuance of KY0053678.

The ash pond effluent is combined and neutralized with condenser cooling water prior to discharge. This mixing and subsequent pH adjustment are required because of high alkalinity which results from the dissolution of metallic oxides and alkalies from the ash. The ash pond pH has ranged from 8.8 to 9.7. The ash pond provides sedimentation, precipitation, and equivalent treatment for iron-bearing chemical cleaning wastes when the pond pH is equal to or greater than 9.0.

002

Outfall 002 is the condenser cooling water (CCW) discharge channel weir overflow. Inputs to the CCW channel include the ash pond discharge, equipment cooling water, treated domestic wastes, cooling water from the AFBC Pilot Plant, and backwash from rotating plant intake screens.

003

Sanitary waste, an internal wastestream, is treated by a septic tank and sand filter prior to discharge to the CCW channel.

004

Metal cleaning wastes are internal wastestreams that include air preheater washing waste and boiler cleaning wastes. Boiler fireside, air preheater, and similar cleaning wastes may be directed to the ash pond without pretreatment provided that dissolved copper concentrations do not exceed 1.0 mg/l. If a minimum ash pond effluent pH of 9.0 is maintained, then an effluent limitation of 1.0 mg/l of iron is deemed to be met for discharges to the ash pond.

Air preheaters are normally washed for up to 72 hours at a washwater flow rate of about 100 gal/min. Normally, up to 7 washings are performed per year.

Typically, three to five boilers are cleaned per year. The following are typical quantities of wastes generated during each cleaning and the typical quantities of chemicals used.

1. Copper solvent (2)	70,000	(2 stages)
2. Iron solvent (1)	35,000	
3. Passivation solution (3)	35,000	
4. Rinse water	350,000	

Notes: (1) 42,000 to 45,000 lbs of 30 percent hydrochloric acid, 55 gal of Rodine 214, and 600 lbs of ammonium biflouride.

(2) 1,500 gal of 28 percent aqueous ammonia, 900 lbs of ammonium bicarbonate, and 700-800 lbs of potassium bromate per stage.

(3) 3,400 lbs of trisodium phosphate and 50-55 gal of hydrazine.

005

Boiler blowdown, an internal wastestream, is discharged to the ash pond. This discharge is addressed by 40 CFR 423 as a low volume waste.

006

Coal pile runoff, an internal wastestream, is discharged to the ash pond. The coal pile storage area is 61.4 acres in size.

007

Presently, there are no point source construction runoff discharges at Shawnee. However, the permittee would like to retain this outfall for any future discharges.

008

This outfall was used for runoff from sludge disposal ponds. This outfall is no longer used and the effected area has been reclaimed.

009

The permittee has requested that this outfall be designated for area runoff from the south side of the plant. This discharge consists of storm water runoff from the plant rail loop area, which is not affected by normal plant operations. The discharge is directed to Little Bayou Creek. The TVA Power Stores Department maintains a drum storage area in this vicinity. The contents of the drums do not include volatile chemicals, solvents, or PCBs. While most are empty, some do contain steam turbine oils. Construction of three buildings that will house the drums is in progress.

010

The outfall is designated for an area on the northeast side of the plant that discharges runoff to a slough which is adjacent to the Ohio River. The area conists of 7 acres that are not affected by plant operations plus a 23-acre parcel which includes parking lots and the eastern half of the switchyard.

2. RECEIVING WATER

a. Receiving Water Name

Ohio River - Discharge 001 at mile point 946
Little Bayou Creek - Discharge 009

b. Stream Segment Use Classification

Warmwater Aquatic Habitat, Primary/Secondary Contact Recreation.

c. Stream Low Flow Condition

Ohio River 7Q10 = 46,550 cfs
Little Bayou Creek 7Q10 = 0 cfs

d. Water Quality Limited or Effluent Limited

Effluent Limited

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 001 - Internal wastestream - ash pond discharged to the CCW channel

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	DMR Data 1982-1984 Average Daily Max.	Proposed Limits Monthly Average	Proposed Limits Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Bottom ash and fly ash sluice, water treatment plant wastes, metal cleaning wastes, low volume wastes, miscellaneous equipment cooling and lubricating water, coal pile runoff, discharges from the AFCB Pilot Plant runoff from the limestone storage area and the spent material-combustion residue area, and low-volume discharges from the scrubber.	Flow (MGD)	27.3	28.9	--	—	
	pH, range	--	8.8-9.7	6.0 (min.)	—	401 KAR 5:080 Section 1(2)(c)2
	TSS	19.2	26.4	30 mg/l	62 mg/l	40 CFR 423.12, 423.13
	Oil & Grease	5.0	5.0	13 mg/l	13 mg/l	40 CFR 423.12, 423.13
	Heavy Metals Monitoring 1/	--	--	--	—	401 KAR 5:080 Section 1(2)(c)2 401 KAR 5:065, Section 2 401 KAR 5:031, Section 4

Authority to reference 40 CFR 423.12, 423.13 is pursuant to 401 KAR 5:065, Section 4(2).

See Attachments C and D for calculation.

1/ Heavy Metals Monitoring shall include total recoverable Iron, Arsenic, Selenium, and Aluminum.

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 002 - once-through cooling water discharged to the Ohio River

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	DMR Data 1982-1984 Average Daily Max.	Proposed Limits Average	Proposed Limits Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Once-through cooling water Units 1 through 10.	Flow, MGD					
	Average	1027	1280	--	--	
	Maximum	1384	1561			
	Temperature, °C					401 KAR 5:080, Section 1 (2)(c)2
	Average	20.1	24.7	--	36.7°C 1/	401 KAR 5:031, Section 4
	Maximum	36.2	37.7		(98.0°F) 2/	and Section 8
	pH					
	Range	-	6.4-8.1	6.0(min.)	9.0	401 KAR 5:031, Section 4(1)(b)
	Free Available Chlorine, mg/l			0.2 mg/l	0.5 mg/l Instantaneous Maximum	40 CFR 423.12
	Average	0.122	0.149			
	Maximum	0.160	0.200			
	Chlorine Addition Period	--	--	--	120 min/ day/unit	
	Heat Discharge BTU/hr	--	--	--	2/ 4/	401 KAR 5:080 Section 1(2)(c)2 401 KAR 5:031, Section 4 & 8

Notes:

1/ In no case may the cooling water discharge raise the stream temperature above the following values outside a reasonable mixing zone as defined by the TVA - Shawnee thermal plume study:

Month/Date	Period Average (°F)	Instantaneous Maximum (°F)
January 1-31	45	50
February 1-29	45	50
March 1-15	51	56
March 16-31	54	59
April 1-15	58	64
April 16-30	64	69
May 1-15	68	73
May 16-31	75	80
June 1-15	80	85
June 16-30	83	87
July 1-31	84	89
August 1-31	84	89
September 1-15	84	87
September 16-30	82	86
October 1-15	77	82
October 16-31	72	77
November 1-30	67	72
December 1-31	52	57

2/ 24-hour average intake temperature, 24-hour average flow, and 24-hour average plant load shall be used in these calculations.

3/ Total residual chlorine may not be discharged from any single generating unit for more than two hours per day unless the discharger demonstrates to the permitting authority that discharge for more than two hours is required for macroinvertebrate control. Simultaneous multi-unit chlorination is prohibited.

4/ In the event that surface elevation of the Ohio River in the vicinity of the plant is below 305 feet MSL, the applicable limitation shall be 8×10^9 BTU/hr.

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 003 - Internal wastestream - sanitary wastes treatment plant effluent discharged to the CCW channel (001).

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	Daily Max.	Proposed Limits Monthly Average	Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Sanitary wastes treatment plant effluent	Flow, MGD	0.007	0.017	--	--	
	pH, range	--	6.4-7.5	6 (min)	9	401 KAR 5:045, Section 3
	BOD_5, mg/l	--	2.2	30 mg/l	45 mg/l	401 KAR 5:045, Section 3
	TSS, mg/l	--	3.5	30 mg/l	45 mg/l	401 KAR 5:045, Section 3
	Fecal Coliform (# colonies/100 ml)	--	13	200/	400/	401 KAR 5:045, Section 3
	Total Residual Chlorine	0.9	1.2	--	--	401 KAR 5:080, Section 1(2)(c)2

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 004 - Internal wastestream - metal cleaning wastes discharged to the ash pond (001).

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	DMR Data 1982-1984 Average Daily Max.	Proposed Limits Monthly Average	Proposed Limits Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Metal cleaning wastes	Flow, MGD	1.1	1.61	--	—	
	Copper, T., mg/l	0.065	0.08	1.0	1.0	40 CFR 423.12, 423.13
	Iron, T., mg/l	--	--	1.0	1.0	40 CFR 423.12, 423.13
	pH	--	--	N/A	N/A	
	Oil and Grease, mg/l	5.8	6.5	N/A	N/A	
	Copper, Dissolved, mg/l	--	--	--	—	401 KAR 5:080, Section 1(2)(c)2

Limitations for iron shall be deemed met by discharge to ash pond, provided that ash pond effluent pH is greater than or equal to 9.0 standard units during the period of discharge and for at least 30 days thereafter.

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 005 - Internal wastestream - boiler blowdown discharged to the ash pond (001).

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	Daily Max.	Proposed Limits Monthly Average	Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Boiler blowdown	Flow, MGD	0.018	0.030	N/A	N/A	
	Copper, mg/l	0.011	0.011	N/A	N/A	

BOILER BLOWDOWN MAY BE DISCHARGED TO THE ASH POND WITHOUT LIMITATION OR MONITORING REQUIREMENTS.

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 006 - Internal wastestream - coal pile runoff discharged to the ash pond (001).

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	Daily Max.	Proposed Limits Monthly Average	Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Coal pile runoff	Flow	--	--	N/A	N/A	

COAL PILE RUNOFF MAY BE DISCHARGED TO THE ASH POND WITHOUT LIMITATION OR MONITORING REQUIREMENTS.

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 007 - Point source construction runoff

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	DMR Data 1982-1984 Average Daily Max.	Proposed Limits Monthly Average	Proposed Limits Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Point source construction runoff	Flow	--	--	N/A	N/A	

NO LIMITATION OR MONITORING REQUIREMENTS.

The permittee shall maintain and implement procedures to assure adequate control of rainfall runoff from the site. Reports shall be submitted one year following the effective date of this permit and 18 months following the effective date of this permit, demonstrating the adequacy of the controls. Subsequent reporting is not necessary unless determined necessary by the Director, Division of Water.

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 009 - Storm water runoff from the rail loop discharged to Little Bayou Creek.

Description of Discharge	Effluent Characteristics	DMR Data 1982-1984 Average Daily Avg.	DMR Data 1982-1984 Average Daily Max.	Proposed Limits Monthly Average	Proposed Limits Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Runoff from the rail loop	Flow	--	--	N/A	N/A	

RUNOFF FROM THE RAIL LOOP MAY BE DISCHARGED WITHOUT LIMITATION OR MONITORING REQUIREMENTS.

The permittee shall maintain and implement procedures to assure adequate control of rainfall runoff from the site. Reports shall be submitted one year following the effective date of this permit and 18 months following the effective date of this permit, demonstrating the adequacy of the controls. Subsequent reporting is not necessary unless determined necessary by the Director, Division of Water.

REPORTED DISCHARGE AND PROPOSED LIMITS

Serial Number 010 - Storm water runoff from the parking lots and the east end of the switchyard to sloughs adjacent to the Ohio River.

Description of Discharge	Effluent Characteristics	Reported Discharge 30-day	Reported Discharge 1-day	Proposed Limits Monthly Average	Proposed Limits Daily Maximum	Applicable Water Quality Criteria and/or Effluent Guidelines
Runoff from parking lots and east end of switchyard areas	Flow	--	--	N/A	N/A	

STORM WATER RUNOFF FROM THE PARKING LOTS AND THE EAST END OF THE SWITCHYARD AREAS MAY BE DISCHARGED WITHOUT LIMITATION OR MONITORING REQUIREMENTS.

The permittee shall maintain and implement procedures to assure adequate control of rainfall runoff from the site. Reports shall be submitted one year following the effective date of this permit and 18 months following the effective date of this permit, demonstrating the adequacy of the controls. Subsequent reporting is not necessary unless determined necessary by the Director, Division of Water.

4. METHODOLOGY USED IN DETERMINING LIMITATIONS

a. Serial Number - 001, 002, 003, 004, 009, 010

b. Effluent Characteristics

Flow, Temperature, pH, TSS, Oil and Grease, Total Residual Chlorine, Free Available Chlorine, Fecal Coliform, Chlorine Addition Period, Copper, Iron

c. Pertinent Factors

Ohio River 7Q10 = 46,550 cfs @ USGS Station No. 03316500

Effluent Guidelines - Part 423 steam electric power plant generating point source category 423.12 (BPT) and 423.13 (BAT).

Attachment A is a location (topo) map for the Shawnee Plant. Attachment B shows the wastewater flow diagram and the flows within the Shawnee Plant (outfall locations). Attachment B also provided the source for the flows used in the calculations. Attachment C). Attachment D shows the calculations involved in computing the rainfall runoff flows and Attachment E shows the data used for the Heavy Metals Monitoring anaylsis at the ash pond.

d. Calculations

The quantity limitations are based upon the daily average and/or daily maximum concentration limitations multiplied by the average discharge rate from each source for the expected peak month. See attachments C for further information on flow values and the limitations calculated by flow-weighted techniques.

e. Conclusions

A. For the purposes of this permit, the limitations were based upon the November 19, 1982 promulgated Best Practicable Control Technology Currently Available (BPT/40 CFR 423.12), Best Available Technology Economically Achievable (BAT/40 CFR 423.13), the permit writer's Best Professional Judgement (BPJ/401 KAR 5:080, Section 1(2)(c)2), and 401 KAR 5:031, Section 4, 5:065, Section 4(2), 5:035, Section 2 and 5:045, Section 3.

B. 001

TSS, Oil and Grease - Limitations for these parameters are consistent with 401 KAR 5:065 Section 4(2) (40 CFR 423.12, 423.13) pursuant to KRS 224.020, 224.033, 224.060. The flows used in conjunction with the limit determination of these parameters were based on historical plant data and the information submitted with the application. See Attachment B for the values used and Attachment C for the actual calculations utilized in making these determinations.

pH - The monitoring requirements for this parameter are based on the Permit Writer's Best Professional Judgement (BPJ) of the Best Conventional Pollutant Technology (BCT) consistent with 401 KAR 5:080, Section 1(2)(c)2, pursuant to KRS 224.020, 224.033, 224.060.

Heavy Metal Monitoring - 401 KAR 5:029, Section 5 states that chronic criteria for the protection of aquatic life are to be met at the edge of the allowable mixing zone, and in no case shall the mixing zone exceed one-half of the cross sectional area of the receiving stream. 401 KAR:029, Section 1 states that the 7Q10 is the governing low flow criterion.

Attachment E compares ambient and effluent values for specific parameters. The average levels of the ash pond discharge for arsenic, cadmium, chromium, iron, manganese, nickel, and zinc are less than the cited criteria. The average levels of the ash pond discharge for copper, lead, and mercury are equal to or less than ambient levels. The average effluent value for selenium is less than the water quality criteria but exceeds the ambient levels. Also, arsenic and selenium are the only two parameters where there is an increase in the intake to the ash pond effluent. It should be noted that the Human Health Criteria for Selenium is 10 ug/l. The ash pond discharge level for selenium exceeds this level and therefore should be checked.

The instream selenium level that would result from a complete mixing of the ash pond effluent with the receiving stream would be 2.15 ug/l. This calculation is based on the following formula:

$$2.15 \text{ ug/l} = \frac{(27.3 \text{ MGD})(32 \text{ ug/l}) + (30090 \text{ MGD})(2.1 \text{ ug/l})(0.5)}{(27.3 + 30090\ (0.5))}$$

where:

27.3	MGD	= ash pond effluent (dry weather)
30090	MGD	= Ohio River, 7Q10 ¶ USGS Station No. 03316500
32	ug/l	= ash pond average selenium level
2.1	ug/l	= ambient average selenium level
	0.5	= one-half of receiving stream cross section

The calculated selenium value does not exceed the cited criteria for either water quality or human health. Since the cited criteria for metals are not significantly impacted by the ash pond discharge, no monitoring for cadmium, chromium, copper, lead, manganese, nickel, zinc and mercury is required. However, continued monitoring for iron, arsenic and selenium will be required to insure no further elevation in the levels of these pollutants or resolubilization of ash pond sediment occurs for these pollutants. Arsenic and selenium increases have been noted in other ash pond effluents where the ash pond is alkaline and has high pH's. High pH's mobilize these two substances. Furthermore, this data would be of particular importance in the event that TVA -Shawnee claims equivalent treatment within their ash pond, where upon they will need this data for generation of historical data curves. Monitoring for aluminum will also be required to check for impacts caused by fly ash discharges. This determination is based on the Permit Writer's Best Professional Judgement (BPJ) of the Best Available Technology Economically Achievable (BAT) consistent with 401 KAR 5:080, Section 1(2)(c)2, and also consistent with 401 KAR 5:065, Section 2 and 401 KAR 5:031, Section 4 pursuant to KRS 224.020, 224.033, 224.060.

002

Temperature, Heat Discharge - The limitation for this parameter is based on the Permit Writer's Best Professional Judgement (BPJ) of the Best Conventional Pollutant Control Technology (BCT) consistent with 401 KAR 5:080, Section 1(2)(c)2, and also consistent with 401 KAR 5:031, Sections 4 and 8 pursuant to KRS 224.020, 244.033, 224.060. The outfall limit for this parameter is left the same as that in the expiring permit pursuant to 401 KAR 5:065, Section 1(11) which states, "when a permit is renewed or reissued, interim limitations, standards or conditions which are at least as stringent as any final limitations, standards, or conditions in the previous permit will be incorporated unless the circumstances on which the previous permit was based have materially and substantially changed since the time the permit was issued and would constitute cause for permit modification or revocation and reissuance under Section 6 of 401 KAR 5:070".

Free Available Chlorine, Chlorine Addition Period -Limitations for these parameters are consistent with 401 KAR 5:065, Section 4(2) (40 CFR 423.12, 423.13) pursuant to KRS 224.020, 224.033, 224.060.

pH - The limitations for this parameter are consistent with 401 KAR 5:031, Section 4(1)(b) pursuant to KRS 224.020, 224.033, 224.060.

003

pH, BOD_5, TSS, Fecal Coliform, Total Residual Chlorine - Limitations for these parameters with respect to Serial Number 003 are consistent with 401 KAR 5:045, Section 3 pursuant to KRS 224.020, 224.033, 224.060. The monitoring requirements for total residual chlorine is based on the Permit Writer's Best Professional Judgement (BPJ) of the Best Conventional Pollutant Control Technology (BCT) consistent with 401 KAR 5:080, Section 1(2)(c)2, pursuant to KRS 224.020, 224.033, 224.060.

004

Copper, Iron - Limitations for these parameters are consistent with 401 KAR 5:065 Section 4(2) (40 CFR 423.12, 423.13) pursuant to KRS 224.020, 224.033, 224.060. Limitations for iron shall be deemed met by discharge to ash pond, provided that ash pond effluent pH is greater than or equal to 9.0 standard units during the period of discharge and for at least 30 days thereafter.

Metal cleaning wastes shall mean cleaning compounds, rinse waters, or any other waterborne residues derived from cleaning anuy metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

005, 006

N/A

007

The permittee shall report all discharges due to point source construction runoff.

008, 009, 010

N/A

5. PROPOSED COMPLIANCE SCHEDULE FOR ATTAINING EFFLUENT LIMITATIONS

See Attached Draft Permit Page I-6.

6. PROPOSED SPECIAL CONDITIONS WHICH WILL HAVE A SIGNIFICANT IMPACT ON THE DISCHARGE

See Attached Draft Permit Pages III-1 through III-3.

Best Management Practices - Due to the potential for the release of toxic substances from ancillary activities to the waters of the Commonwealth through plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material runoff, the Division is requiring that a BMP plan be prepared. This determination is based on the Permit Writer's Best Professional Judgment (BPJ) consistent with 401 KAR 5:080 Section 1(2)(c)2 and was also consistent with 401 KAR 5:065 Section 2 (10) both pursuant to KRS 224.020, 224.033, 224.060.

7. PERMIT DURATION

The KPDES permit limitations ensure compliance with prior permit limitations. Data in the application including the priority pollutant data and best professional judgments based on information available for other power plants indicates that additional treatment is not likely to be necessary for priority pollutants. Therefore, it is proposed that a five-year permit be issued.

8. THE ADMINISTRATIVE RECORD

The Administrative Record, including application, draft permit, fact sheet, public notice, comments received, and additional information is available by writing the Division of Water at 18 Reilly Road, Fort Boone Plaza, Frankfort, Kentucky 40601.

9. REFERENCES AND CITED DOCUMENTS

All materials and documents referenced or cited in this fact sheet are either a part of the Administrative Record as described in Item 8 on this page or readily available at the Division of Water.

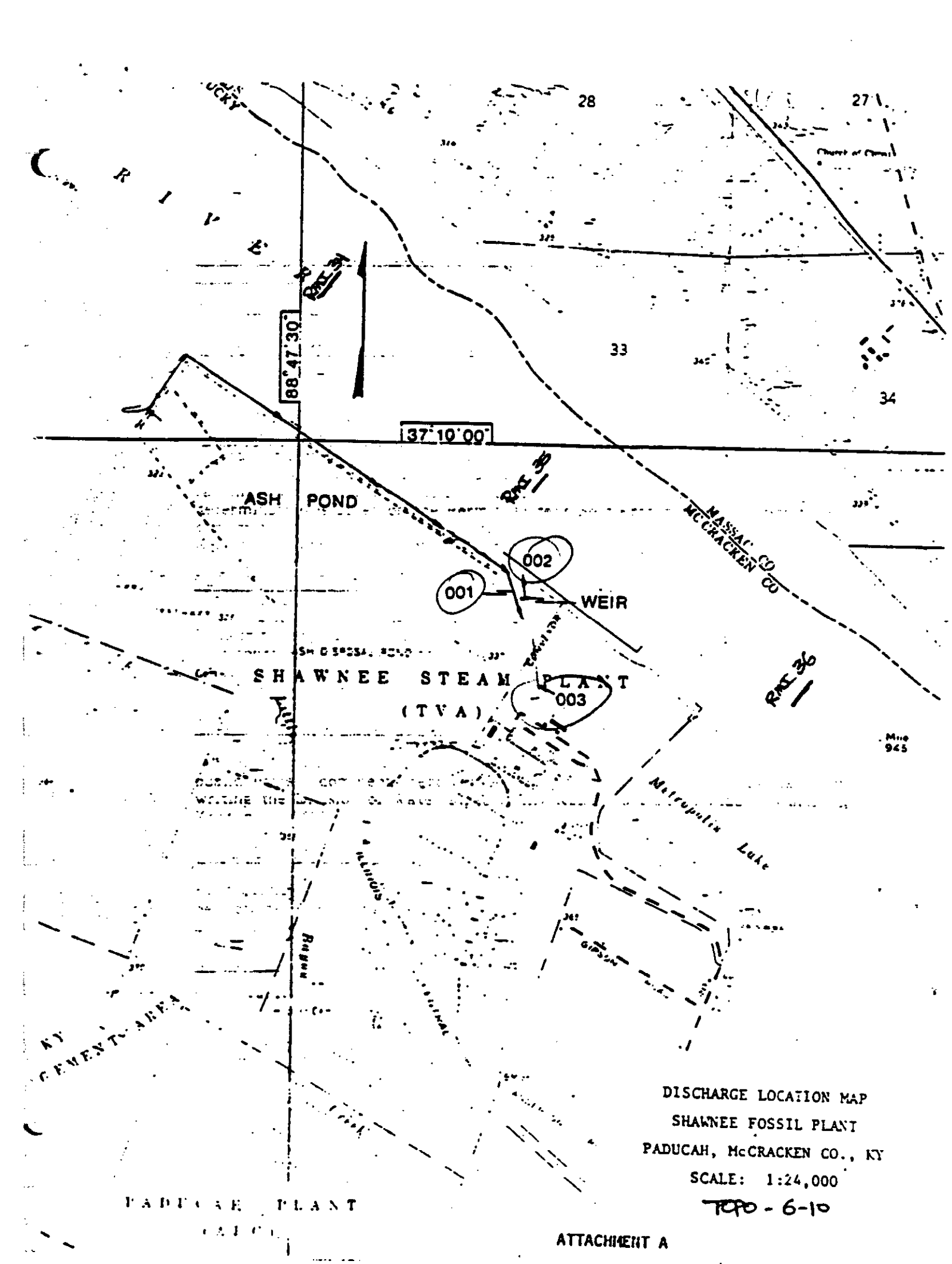
10. CONTACT

R. Bruce Scott (502) 564-34110, extension 470.

11. PUBLIC NOTICE INFORMATION

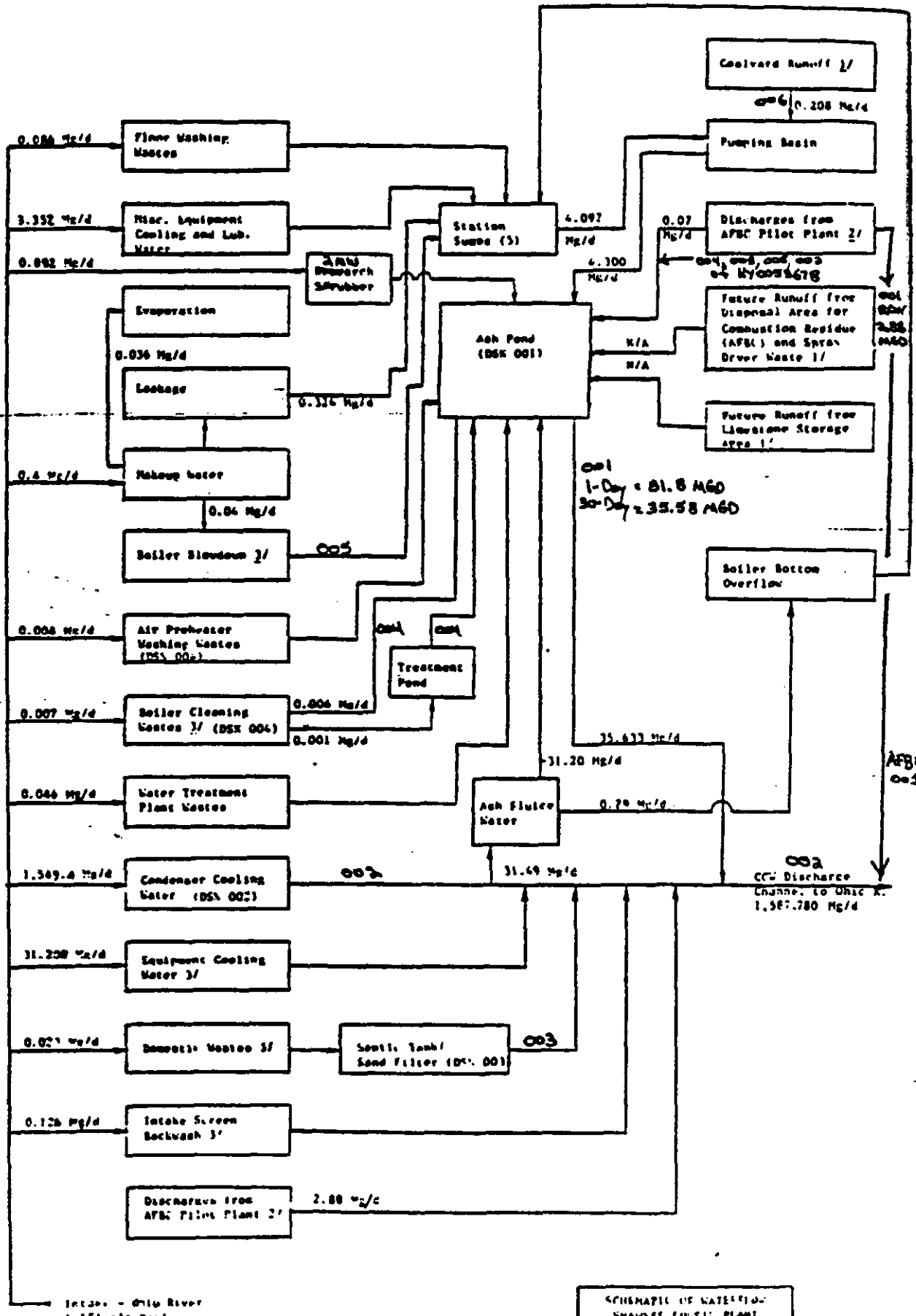
Please refer to the attached Public Notice for details regarding the procedures for a final permit decision, deadline for comments and other information required by 401 KAR 5:075, Section 4(2)(e).

For further information, contact the individual identified on the Public Notice of the permit writer - R. Bruce Scott at (502) 564-3410, extension 470.



DISCHARGE LOCATION MAP
SHAWNEE FOSSIL PLANT
PADUCAH, McCRACKEN CO., KY
SCALE: 1:24,000
TOPO - 6-10

ATTACHMENT A



SCHEMATIC OF WATER FLOW
SHAWNEE FOSSIL PLANT
KY0004219
PADUCAH, McCRACKEN CO., KY

ATTACHMENT B

TVA - SHAWNEE

WASTESTREAM	TOTAL SUSPENDED SOLIDS AVERAGE MG/L	TOTAL SUSPENDED SOLIDS AVERAGE LBS/DAY	TOTAL SUSPENDED SOLIDS MAXIMUM MG/L	TOTAL SUSPENDED SOLIDS MAXIMUM LBS/DAY	OIL AND GREASE AVERAGE MG/L	OIL AND GREASE AVERAGE LBS/DAY	OIL AND GREASE MAXIMUM MG/L	OIL AND GREASE MAXIMUM LBS/DAY	FLOW 1/ MGD
Units 1-10									
Bottom & fly ash sluice	30	7,811	100	26,036	15	3,905	20	5,207	31.20
Water treatment plant	30	12	100	38	15	6	20	8	0.046
Metal cleaning 2/	--	--	--	--	--	--	--	--	--
Low volume wastes	30	104	100	347	15	52	20	69	0.416
Cooling, lubricating and make-up leakage	30	920	30	920	0	0	0	0	3.676
Research scrubber	30	1	100	2	15	0	20	0	0.002
AFBC									
Low volume wastes	30	9	100	31	15	5	20	6	0.037
Sanitary waste	30	1	45	1	0	0	0	0	0.002
Subtotal W/O Precipitation	30	8,858	93	27,375	13	3,968	18	5,290	35.379
Direct rainfall on ash pond & ash									
30 day	30	36	N/A	N/A	0	0	N/A	N/A	0.142
1 day	N/A	N/A	30	6,109	N/A	N/A	0	0	24.4
Coal pile runoff									
30 day	30	52	N/A	N/A	0	0	N/A	N/A	0.208
1 day	N/A	N/A	50	3,463	N/A	N/A	0	0	8.3
AFBC runoff									
30 day	30	8	N/A	N/A	0	0	N/A	N/A	0.031
1 day	N/A	N/A	50	5,800	N/A	N/A	0	0	13.9
Total W/Precipitation									
30-Day	30	8,954	N/A	N/A	13	3,968	N/A	N/A	35.76
1-Day	N/A	N/A	62	42,747	N/A	N/A	8	5,290	81.979

1/ Flow values as reported by TVA (Form 2C application) compare well with months of peak flows.

2/ Ash sluice operations and metal cleaning operations are not conducted simultaneously for a single unit, therefore, metal cleaning wastes are neglected here.

ATTACHMENT C

ATTACHMENT D

RAINFALL RUNOFF CALCULATIONS

001

30-Day Flow

Based on TVA estimates

Source	Average Flow MGD
Direct runoff on ash pond	(none listed)
Coal pile	0.208
Direct rainfall onto ash pond minus evaporation	0.142
AFBC (Coal storage area, limestone storage area, wet dust supression, combustion residue disposal area)	0.031

1-Day Flow

Source	Drainage Area (Acres)	Flow Resulting from a 10-yr, 24-hr Rainfall (MGD) 1/
Coal yard drainage	61.4	8.3
Direct rainfall onto ash pond & ash	180	24.4
Limestone storage area	2	0.3
Disposal area for combustion residue	100	13.6

Note:

$$1/(\text{Acres}) \times \frac{43560\ ft^2}{\text{acre}} \times \frac{5\ \text{inches-rain}}{\text{day}} \times \frac{1\ \text{ft.}}{12\ \text{in.}} \times \frac{7.48\ \text{gal}}{ft^3} \times \frac{1\ \text{MG}}{1{,}000{,}000\ \text{gal}} \times (Cr)$$

where a runoff coefficient, Cr = 1.0 is assumed.

ATTACHMENT E

SHAWNEE STEAM PLANT

Parameter, ug/l 1/	Ambient Water Quality No. Obs. 2/	Avg.	Max.	Water Quality Criteria 3/		Ash Pond - 001 Effluent 9/ Avg.	Max.
Arsenic (T)	15	7	24	50	4/	32	47
Cadmium (T)	13	1.2	4	12	4/	0.9	6
Chromium (T)	14	11	34	100	4/	9.8	17
Copper (T)	14	51	120	33	8/	34	180
Iron (T)	30	1,528	3,500	1000	4/	592	1,600
Lead (T)	14	13	30	5.6	5/	6.9	18
Manganese (T)	29	94	210	50	6/	22	50
Mercury (T)	15	0.2	0.2	0.2	4/	0.2	0.2
Nickel (T)	14	50	50	133	7/	11	50
Selenium (T)	15	2.1	9	35	7/	32	47
Zinc (T)	14	48	110	70	8/	21	80

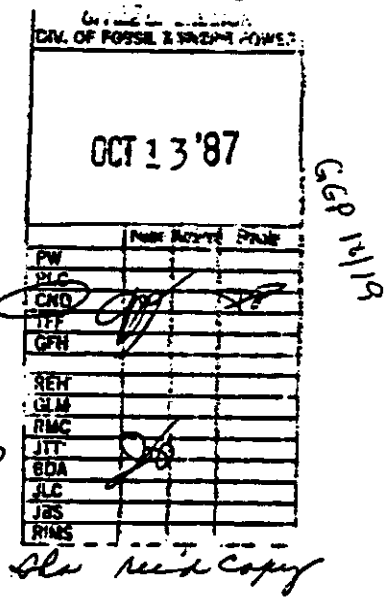
Notes:

1/ All parameters are reported as total metal.
2/ Data collected at plant intake by TVA. Average includes data points which are less than the limit of detectability as if they were equal to the limit of detectability.
3/ Criteria based on an average calcium carbonate hardness of 155 mg/l. The most stringent applicable criteria is listed.
4/ 401 KAR 5:301, Section 4, Warmwater Aquatic Habitat, use as Total Recoverable.
5/ 50 FR 30784, 7/29/85, use as Total Recoverable.
6/ 401 KAR 5:301, Section 5, Domestic Water Supply (for comparison purposes).
7/ 45 FR 79318, 11/28/80, use as Total Recoverable.
8/ 401 KAR 5:031, Section 8.
9/ DMR data for the period 1/82 to 12/84 (13 observations).

CXC MBS

M01 871013 218

OCT 8 1987



GGP 10/19

10/16

10/15

Mr. Donald F. Harker, Jr., Director
Division of Water
Kentucky Department for Environmental
Protection
Fort Boone Plaza
18 Reilly Road
Frankfort, Kentucky 40601

Dear Mr. Harker:

SHAWNEE FOSSIL PLANT - MODIFICATION OF KPDES PERMIT NO. KY0004219

Enclosed are a revised wastewater flow schematic, discharge location map, and the Kentucky Pollutant Discharge Elimination System permit application form C which incorporate various proposed changes at Shawnee Fossil Plant. We request that the Shawnee KPDES permit be modified as described below to include changes associated with the planned construction of an ash dredging pond, the dry ash handling system presently under construction, and the proposed consolidated waste disposal area. In addition, the permit should be revised to include two point source discharges of seepage from the northeast portion of the ash pond. We are presently scheduling the sampling of all point source discharges of rainfall runoff for priority pollutant analyses. Revised descriptions of the Shawnee stormwater runoff discharges will be submitted with the priority pollutant data which is to be reported in October.

Ash Dredging Pond

Based on the ash pond volume and projected coal burn at Shawnee, it will be necessary to dredge the active ash pond in the fall of 1987 to comply with KPDES suspended solids limitations. Thus, we are planning to construct a 35-acre dredge pond in the northwest corner of the abandoned ash disposal area adjacent to the active ash pond. The dredge pond will be constructed using a dragline to excavate previously sluiced ash and stack the material around the perimeter to form a dike. Dredging is scheduled to begin in October 1987 and continue for three or four months. During that time, approximately 350,000 cubic yards of ash will be dredged to this pond with the carriage water being returned to the active ash pond. After the dredged ash stabilizes, dry ash from the proposed dry collection system will be stacked on this area.

Dry Ash Handling System

In order to provide for sale of fly ash and to prolong the operating life of the ash pond, TVA is planning dry handling and disposal of fly ash from the nine pulverized coal (PC) units, wastes from the 160-MW atmospheric fluidized bed combustion (AFBC) unit (under construction), and wastes from a 160-MW dry flue gas desulfurization (DFGD) spray absorber (proposed). The new dry ash handling system will require the addition of two wastewater sumps. One sump will collect drainage from washdown pads located under the fly ash transfer silo and inside the transfer blower building. The other sump will collect drainage from washdown pads in the disposal silo area and from door spray curtains in the pan loading area. All washdown drainage will be pumped from the two collection sumps to the ash pond.

Consolidated Waste Disposal

TVA is planning to codispose of fly ash, AFBC wastes, and DFGD wastes in a dry stack located on the 100-acre inactive ash disposal area. Runoff from this area will be collected in a drainage basin and pumped to the ash pond. A perimeter ditch will be excavated to direct runoff to this drainage basin and, to a lesser extent, to the coalyard runoff pond. The drainage basin will be designed to handle peak flows from the 10-year, 24-hour rainfall event; and the drainage ditches will be designed for a 100-year, 24-hour rainfall.

Ash Pond Seepage

Two point source discharges of ash pond seepage have been identified at Shawnee. Seepage originating in the toe ditch along the northeast section of the ash pond dike flows into the ash pond discharge channel at a rate of approximately 2 gpm. A sample of the seepage had a pH of 9.0 and contained 3.52 mg/L aluminum, 0.005 mg/L arsenic, <0.01 mg/L copper, 6.23 mg/L iron, 0.736 mg/L manganese, and <0.001 mg/L selenium. The ash pond discharge channel also receives a flow of approximately 10 gpm originating across the road from the northeast section of the ash pond dike. A sample collected near the outfall had a pH of 7.3 and contained 0.16 mg/L aluminum, 0.003 mg/L arsenic, <0.01 mg/L copper, 1.06 mg/L iron, 4.31 mg/L manganese, and <0.001 mg/L selenium.

The KPDES permit application wastewater flow schematic and form C have been revised to clarify the routing of miscellaneous raw cooling water discharges. As indicated, these discharges of noncontact raw cooling water enter the receiving water via the following conveyances:

Mr. Donald F. Harker, Jr., Director

OCT 8 1987

1. Direct discharge into the condenser cooling water (CCW) discharge tunnel.

2. Discharge to the CCW channel via the yard drainage system.

3. Discharge to the ash pond via powerhouse station sumps.

4. Discharge into the intake via the yard drainage system.

As requested by Joe Deavers of the Paducah Field Office during a recent compliance inspection, we have collected samples of the baghouse I.D. fan cooling water discharge (to the CCW channel via the yard drainage system). The samples, which were collected on August 26, 1987, contained less than 5 mg/L and 26.5 mg/L respectively of oil and grease and total suspended solids and had a pH value of 7.8 standard units.

If you have any questions concerning our permit modification request, please call Richard Shane at (615) 632-6654 in Knoxville.

Sincerely,
Original Signed by
Martin E. Rivers
Martin E. Rivers, Director
Environmental Quality

ARL:MFB
Enclosures
cc (Enclosures):
Files, EQS, 242 SPB-K
B. W. Brown, 140 EB-K
E. S. Christenbury, E11 B33 C-K
C. L. Massey, MR 5N 52A-C
O. T. Massey, Shawnee
P. Wade, LP 3S 58K-C

Prepared by Alicia R. Lewis (F&H PR) with concurrence by Richard M. Shane

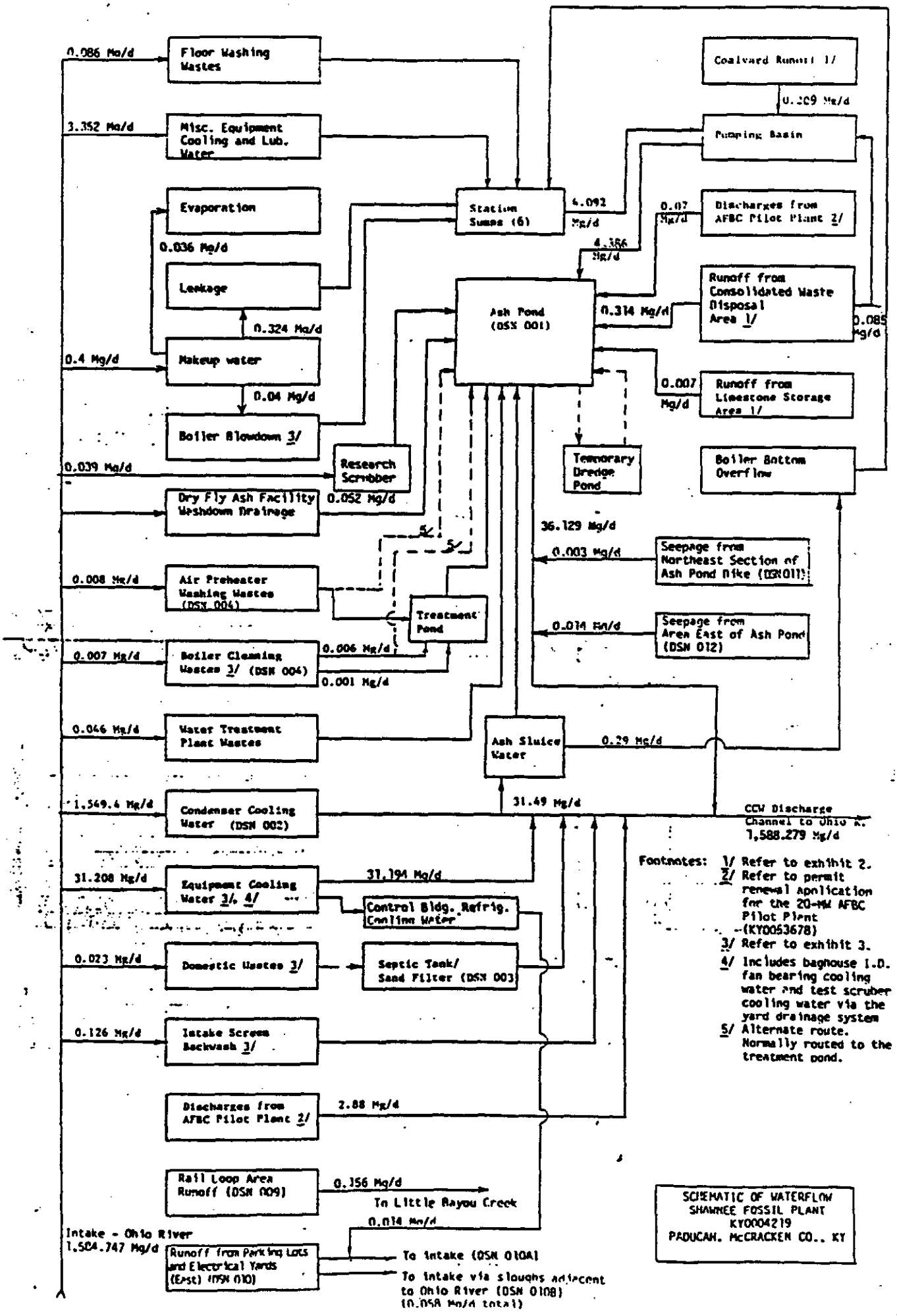

0.086 Mg/d
Floor Washing Wastes
3.352 Mg/d
Misc. Equipment Cooling and Lub. Water
Evaporation
0.036 Mg/d
Leakage
0.324 Mg/d
0.4 Mg/d
Makeup water
0.04 Mg/d
Boiler Blowdown 3/
0.039 Mg/d
Research Scrubber
Dry Fly Ash Facility Washdown Drainage
0.052 Mg/d
0.008 Mg/d
Air Preheater Washing Wastes (DSN 004)
0.007 Mg/d
Boiler Cleaning Wastes 3/ (DSN 004)
0.006 Mg/d
0.001 Mg/d
Treatment Pond
0.046 Mg/d
Water Treatment Plant Wastes
1,549.4 Mg/d
Condenser Cooling Water (DSN 002)
31.208 Mg/d
Equipment Cooling Water 3/ 4/
31.194 Mg/d
Control Bldg. Refrig. Coolinn Water
0.023 Mg/d
Domestic Wastes 3/
Septic Tank/ Sand Filter (DSN 003)
0.126 Mg/d
Intake Screen Backwash 3/
Discharges from AFBC Pilot Plant 2/
2.88 Mg/d
Rail Loop Area Runoff (DSN 009)
0.356 Mg/d
To Little Rayou Creek
Intake - Ohio River
1,504.747 Mg/d
Runoff from Parking Lots and Electrical Yards (East) (DSN 010)
0.014 Mg/d
To intake (DSN 010A)
To intake via sloughs adjacent to Ohio River (DSN 010B)
(0.058 Mg/d total)
Station Sumps (6)
4.092 Mg/d
0.07 Mg/d
4.386 Mg/d
Ash Pond (DSN 001)
0.314 Mg/d
0.007 Mg/d
Temporary Dredge Pond
36.129 Mg/d
0.003 Mg/d
Seepage from Northeast Section of Ash Pond Dike (DSN011)
0.014 Mg/d
Seepage from Area East of Ash Pond (DSN 012)
Ash Sluice Water
0.29 Mg/d
31.49 Mg/d
Coalyard Runoff 1/
0.209 Mg/d
Pumping Basin
Discharges from AFBC Pilot Plant 2/
Runoff from Consolidated Waste Disposal Area 1/
0.085 Mg/d
Runoff from Limestone Storage Area 1/
Boiler Bottom Overflow
CCW Discharge Channel to Ohio R.
1,588.279 Mg/d
Footnotes: 1/ Refer to exhibit 2.
2/ Refer to permit renewal application for the 20-MW AFBC Pilot Plant (KY0053678)
3/ Refer to exhibit 3.
4/ Includes baghouse I.D. fan bearing cooling water and test scruber cooling water via the yard drainage system
5/ Alternate route. Normally routed to the treatment pond.
SCHEMATIC OF WATERFLOW
SHAWNEE FOSSIL PLANT
KY0004219
PADUCAH, McCRACKEN CO., KY

Exhibit 1
Basis for Reported
Wastewater Flow Rates
Shawnee Fossil Plant (KY0004219)

The (nonrunoff related) wastewater flow rates indicated on the flow schematic and on form C represent our best estimate of the "expected maximum dry weather flows." The basis for these values are discussed below. Refer to exhibit 2 for a list of contributing storm water sources and their corresponding flows.

Ash sluice water--The reported value (31.49 Mg/d) is the sum of:

1. Measured rates for the bottom ash sluice water and water used to sluice fly ash collected by the baghouses (31.04 Mg/d).

2. Measured induced bottom ash flow (0.24 Mg/d).

3. Estimated flow for sluicing ash from the mechanical precipitators (0.21 Mg/d).

Water treatment plant wastes--The maximum total daily filter backwash water amount during 1984 was 20,800 gal. The expected maximum daily volume of demineralizer wastes is 24,800 gal. The reported value (0.046 Mg/d) is the sum of these volumes.

Sewage treatment plant (DSN 003)--The value reported (0.023 Mg/d) is the highest daily flow for 1984.

Boiler cleaning wastes--The following are quantities of wastes generated during each cleaning and the quantities of chemicals used:

1.	Copper solvent 2/:	70,000 gal (2 stages)
2.	Iron solvent 1/:	35,000 gal
3.	Passivation solution 3/:	35,000 gal
4.	Rinse water (approx.):	350,000 gal
		490,000 gal (total)

1/ 42,000 to 45,000 lbs of 30 percent HCl, 55 gal of Rodine 214, and 600 lbs of ammonium biflouride.

2/ 1,500 gal of 28 percent aqueous ammonia, 900 lbs of ammonium bicarbonate, and 700-800 lbs of potassium bromate per stage.

3/ 3,400 lbs of trisodium phosphate and 50-55 gal of hydrazine.

The plant normally has 3 to 5 cleanings per year. The reported value (0.007 Mg/d) represents 5 cleanings per year divided by 365 days per year.

Air preheater washing wastes--Air preheaters are normally washed for up to 72 hours at a washwater flow rate of about 100 gal/min. Normally, up to 7 washings are performed per year. We have reported the total annual volume of washwater divided by 365 days per year (0.008 Mg/d).

Once-through cooling water--The reported flow (1,549.4 Mg/d) is the design flow rate for the condensers.

Intake screen backwash--This is an estimated flow (0.126 Mg/d).

Boiler blowdown--The highest measured flow for 1984 (0.040 Mg/d) is indicated.

Evaporation--the value shown (0.036 Mg/d) is the calculated maximum loss from sootblowing.

Floor washing wastes--This is an estimated flow (0.086 Mg/d).

Equipment cooling water discharged to the CCW channel and intake--The total cooling water flow (based on pump capacities) is 34.56 Mg/d. All cooling water discharges to the station sumps, the condenser cooling water channel, or to the intake via the yard drainage system. The reported flow (31.208 Mg/d) is the difference between the total cooling water flow rate and the flow of cooling water to the station sumps (see below). The flow rate for the discharge to the intake via DSN 010A is based on a visual estimate.

Station sump discharge--The total flow from the sumps (4.09 Mg/d) was determined by measuring the rate at which the water level rises in the sumps while the pumps are off. The rate of rise was multiplied by the cross sectional areas of the sumps.

Makeup water leakage discharged to the station sumps--This is the quantity of total makeup which cannot be accounted for by evaporation or blowdown.

Boiler bottom overflow discharged to the station sumps--The reported flow (0.29 Mg/d) is based on visual estimates.

Miscellaneous equipment cooling and lubricating water discharged to the station sumps--The flow rates for all other sources to the station sumps were subtracted from the total station sump flow to arrive at the reported value (3.352 Mg/d).

Low-volume waste discharges from the research scrubber--Based on material balances.

MBS:SGC
8/27/87

Dry fly ash facility washdown drainage--This is an estimated flow based on anticipated normal sump influent flows and pump operation.

Seepage from northeast section of ash pond dike--The reported flow is based on a visual estimate.

Seepage from area east of ash pond--The reported flow is based on a visual estimate.

ARL:SGC
7/10/87

Exhibit 2
Rainfall Runoff Discharges to
the Ash Pond (DSN 001) and
Corresponding 10-Year, 24-Hour Rainfall Flows
Shawnee Fossil Plant (KY0004219)

Description	Drainage Area (Acres)	Flow Resulting from a 10-yr, 24-hr Rainfall (Mg/d)1/
Coalyard Drainage	61.4	8.3
Direct Rainfall onto Ash Pond	180	24.4
Limestone Storage Area (Future discharge associated with add-on AFBC Boiler)	2±	0.3
Consolidated Waste Disposal Area (Future discharge associated with the add-on AFBC Boiler and dry fly ash handling system). This area would also be used for disposal of wastes from the proposed spray dryer flue gas desulfurization system.	117.2	15.9

1/ For a rainfall event of 5 inches in 24 hours, assuming a runoff coefficient of 1.0.

ARL:SGC
7/10/87

Exhibit 3
Shawnee Fossil Plant
160-MW AFBC Demonstration
Add-On Boiler
Wastewater Flows

Listed below are all nonrunoff sources, the corresponding maximum expected flows, and the discharge location for each source. We have not included flows that are unchanged from unit 10 (e.g., CCW flow).

Source	Max. Expected Flow (gal/d)	Point of discharge
Metal cleaning	250,000-500,000 gallons[1]	Ash pond or metal cleaning pond
Boiler blowdown	3,210	Ash pond or CCW discharge channel
Boiler building sump	2,000	Coalyard drainage basin
Equipment cooling	1,300,000	CCW discharge channel
Sanitary	0[2]	Sanitary waste treatment system
Strainer backwash	72,000	CCW discharge channel

Notes:

[1]Estimate for preoperational chemical cleaning. Thereafter, flow would be intermittent (e.g., once every three to five years).

[2]No significant increase over unit 10 flow.

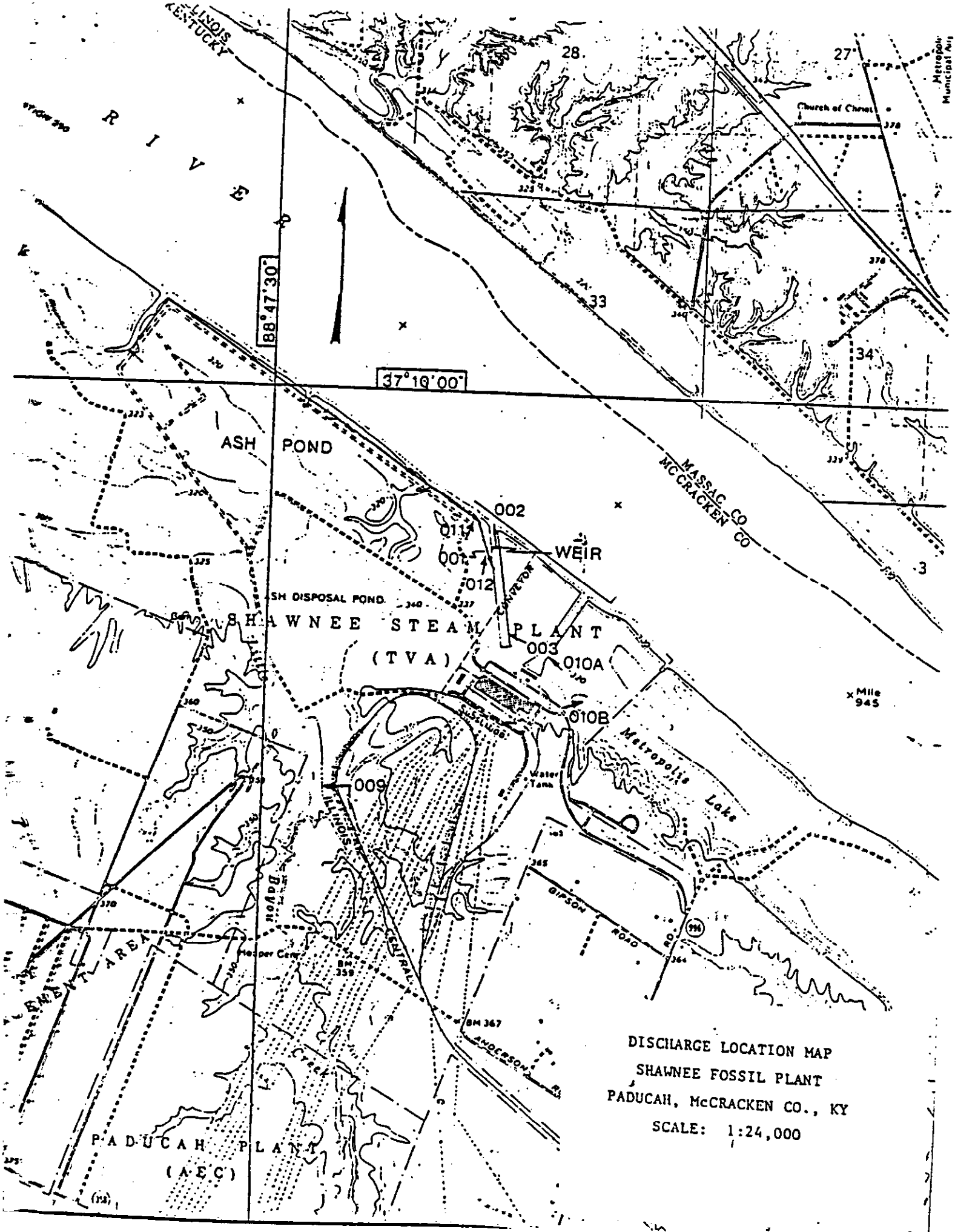
MBS:KTS
4/29/85

Exhibit 4
Wastewater Discharges Associated with the Lime Spray
Dryer Desulfurization System
(Proposed)

		Acreage	Amounts	Discharge Point
1.	Lime Storage Area Sump	Enclosed Area	Intermittent	Coal Pile Drainage
2.	Reagent/Recycle Area Sump	Enclosed Area	Intermittent	Shawnee Ash Pond via Bottom Ash Line
3.	Waste Silo Area Sump	Less than 1/4 acre	Intermittent	Shawnee Ash Pond with Waste Disposal Runoff
4.	Raw Water Supply Filter Backflushing	-	200 gal/min (max.)	Shawnee CCW via Storm Drainage
5.	Waste Disposal Area Runoff	TBD*	TBD*	Shawnee Ash Pond
6.	Sanitary Waste (No significant increase)	-	-	Sanitary Waste Treatment System

*To be determined

MBS:KTS
5/7/85



DISCHARGE LOCATION MAP
SHAWNEE FOSSIL PLANT
PADUCAH, McCRACKEN CO., KY
SCALE: 1:24,000

II. FLOWS, SOURCES OF POLLUTION, AND TREATMENT TECHNOLOGIES

A. Attach a line drawing showing the water flow through the facility. Indicate sources of intake water, operations contributing wastewater to the effluent, and treatment units labeled to correspond to the more detailed descriptions in Item B. Construct a water balance on the line drawing by showing average flows between intakes, operations, treatment units, and outfalls. If a water balance cannot be determined (e.g., *for certain mining activities*), provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures.

B. For each outfall, provide a description of: (1) All operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and storm water runoff; (2) The average flow contributed by each operation; and (3) The treatment received by the wastewater. Continue on additional sheets if necessary.

1. OUTFALL NO. (list)	2. OPERATION(S) CONTRIBUTING FLOW		3. TREATMENT	
	a. OPERATION (list)	b. AVERAGE FLOW (include units)	a. DESCRIPTION	b. LIST CODES FROM TABLE 2C-1
001	(10) Dry fly ash facility	0.052 Mg/d		
(cont)	washdown drainage			
	(future)			

II. FLOWS, SOURCES OF POLLUTION, AND TREATMENT TECHNOLOGIES

A. Attach a line drawing showing the water flow through the facility. Indicate sources of intake water, operations contributing wastewater to the effluent, and treatment units labeled to correspond to the more detailed descriptions in Item B. Construct a water balance on the line drawing by showing average flows between intakes, operations, treatment units, and outfalls. If a water balance cannot be determined *(e.g., for certain mining activities)*, provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures.

B. For each outfall, provide a description of: (1) All operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and storm water runoff; (2) The average flow contributed by each operation; and (3) The treatment received by the wastewater. Continue on additional sheets if necessary.

1. OUTFALL NO. (list)	2. OPERATION(S) CONTRIBUTING FLOW		3. TREATMENT		
	a. OPERATION (list)	b. AVERAGE FLOW (include units)	a. DESCRIPTION	b. LIST CODES FROM TABLE 2C-1	
N/A	Discharge from condenser	1,588.279 Mg/d	Neutralization (of DSN 001)	2	K
	cooling water channel which		Discharges to surface water	4	A
	receives flow from the				
	following sources:				
	(1) Once-through cooling	1,549.4 Mg/d			
	water from the main unit				
	condensers (DSN 002)				
	(2) Ash pond discharge	36.129 Mg/d			
	(DSN 001)				
	(3) Discharge of equipment	31.194 Mg/d			
	cooling water				
	(4) Discharge of treated	0.023 Mg/d	Domestic wastes are treated		
	domestic wastes (DSN 003)		by a septic tank/sand filter		
			system:		
	(5) Discharge from AFBC	2.88 Mg/d	(1) Settling	1	U
	Pilot Plant (Refer to		(2) Anaerobic treatment	3	C
	permit renewal application		(3) Trickling filtration	3	H
	for the 20-MW AFBC Pilot		(4) Disinfection	2	F
	Plant, NPDES Permit		The retention time (average)		
	No. KY0053678).		is approximately 1-day.		
			Sludge is disposed of by		
	(6) Backwash from rotating	0.126 Mg/d	contractor		
	plant intake screens				
	(7) Withdrawal of condenser	(-) 31.49 Mg/d			
	cooling water for ash				
	sluicing				
	(8) Seepage from northeast	0.003 Mg/d			
	section of ash pond dike				
	(DSN 011)				

OFFICIAL USE ONLY *(effluent guidelines sub-categories)*

II. FLOWS, SOURCES OF POLLUTION, AND TREATMENT TECHNOLOGIES

A. Attach a line drawing showing the water flow through the facility. Indicate sources of intake water, operations contributing wastewater to the effluent, and treatment units labeled to correspond to the more detailed descriptions in Item B. Construct a water balance on the line drawing by showing average flows between intakes, operations, treatment units, and outfalls. If a water balance cannot be determined *(e.g., for certain mining activities)*, provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures.

B. For each outfall, provide a description of: (1) All operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and storm water runoff; (2) The average flow contributed by each operation; and (3) The treatment received by the wastewater. Continue on additional sheets if necessary.

1. OUTFALL NO. (list)	2. OPERATION(S) CONTRIBUTING FLOW		3. TREATMENT		
	a. OPERATION (list)	b. AVERAGE FLOW (include units)	a. DESCRIPTION	b. LIST CODES FROM TABLE 2C-1	
	(a) Seepage from area east of ash pond (DSN 012)	0.014 Mg/d			
009	Stormwater runoff from rail loop area	0.156 Mg/d	Discharges to surface water	4	A
010A 010B	Storwater runoff from parking lots and electrical yards (east). Also, 010A includes air conditioning refrigerant condenser cooling water (0.014 MGD).	0.058 Mg/d (total)	Discharges to surface water	4	A

OFFICIAL USE ONLY *(effluent guidelines sub-categories)*

APPENDIX C

- Flood Insurance Rate Maps (FIRM) for McCraken County, Kentucky
- National Wetlands Inventory Map for Joppa, Illinois
- Joppa, Illinois - Kentucky Quadrangle Map